

Shelve in stacks S.B.T.

Highway Safety Literature

An Announcement
of Recent Acquisitions. . .

HSL No. 71-17
June 4, 1971



THIS ISSUE CONTAINS:

HS-009 013 - HS-009 107
HS-800 421
HS-800 428 - HS-800 429
HS-800 462, & HS-800 483
HS-810 155

U.S. Department of Transportation / National Highway Traffic Safety Administration

71-17
HSL No. 71-17 JUNE 4, 1971
HS-800 483, HS-810 155.

HS-009 013 - HS-009 107, HS-800 421, HS-800 428 - HS-800 429 & HS-800 462.

HIGHWAY SAFETY LITERATURE

AN ANNOUNCEMENT OF RECENT ACQUISITIONS

Published Bi-Weekly (26 times a year) by the National Highway Traffic Safety Administration

Washington, D. C. 20591

INTRODUCTION

Publications announced in *Highway Safety Literature* include the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 71 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in location citations by the HS-number, the cover bears the inclusive entry numbers for each issue.

Entries in *HSL* are arranged according to the revised NHTSA Subject Category List shown in the Table of Contents. The List is a two-level arrangement consisting of five major subject fields subdivided into 58 subject groups. Documents related directly to the National Highway Traffic Safety

Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration; or for purchase from NTIS (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array

NHSB Accession no..... HS-800 218 Fld. 5/21; 5/9
Title of document..... AN INVESTIGATION OF USED CAR SAFETY STANDARDS-SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L
Personal author(s)..... by E. N. Wells; J. P. Fitzmaurice; C. E. Guilliams; S. R. Kalin; P. D. Williams
Corporate author..... Operations Research, Inc.
Collation.....
Publication date..... 12 Sep 1969 150p
Contract FH-11-6921
Report no. ORI-TR-553-Vol-6; PB-190 523
Abstract..... Appendices G-L to this study of used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.

Search terms: Wear /Trucks;
Failures /Trucks; Used cars; Inspection standards /Trucks; Inspection standards /Data

AVAILABILITY: NTIS

HS-004 497 Fld. 5/19

AUTO THEFT--THE PROBLEM AND THE CHALLENGE

by Thomas A. Williams, Sr.

Journal citation . . . Published in *FBI Law Enforcement Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto theft problem and comments on antitheft devices available now or in the planning stage.

Search terms: Theft, Theft protection, Stolen cars

TABLE OF CONTENTS

NOTE: () Numbers in parentheses following certain subject groups indicate the Highway Safety Program Standards (No. 1, and up) and/or Federal Motor Vehicle Safety Standards (No. 101 and up) which may apply to these groups.

INTRODUCTION AND SAMPLE ENTRIES	Inside Front Cover
AVAILABILITY OF DOCUMENTS	ii

NHTSA SUBJECT FIELDS AND GROUPS

1/0 ACCIDENTS	1
/1 Emergency Services (11, 15-16)	
/2 Injuries	
/3 Investigation and Records (10, 14-15)	
/4 Locations (9, 14)	
 2/0 HIGHWAY SAFETY	 4
/1 Breakaway Structures	
/2 Communications	
/3 Debris Hazard Control and Cleanup (15-16)	
/4 Design and Construction (12, 14)	
/5 Lighting (14)	
/6 Maintenance (12)	
/7 Meteorological Conditions	
/8 Police Traffic Services (15)	
/9 Traffic Control (13-14)	
/10 Traffic Courts (7)	
/11 Traffic Records (10)	
 3/0 HUMAN FACTORS	 7
/1 Alcohol (8, 14)	
/2 Anthropomorphic Data	
/3 Cyclists	
/4 Driver Behavior	
/5 Driver Education (4, 14)	
/6 Driver Licensing (5, 10, 14)	
/7 Drugs Other Than Alcohol	
/8 Environmental Effects	
/9 Impaired Drivers	
/10 Passengers	
/11 Pedestrians (14-15)	
/12 Vision	

4/0 OTHER SAFETY-RELATED AREAS	13
/1 Codes and Laws (6)	
/2 Community Support (17)	
/3 Cost Effectiveness	
/4 Governmental Aspects	
/5 Information Technology	
/6 Insurance	
/7 Mathematical Sciences	
/8 Transportation Systems	

5/0 VEHICLE SAFETY	15
-------------------------------------	-----------

* All Federal Motor Vehicle Safety Standards apply to passenger vehicles. An asterisk before a subject group indicates additional types of vehicles to which the indicated standards may apply.

/1 Brake Systems (102, 105-6, 116)	
* /2 Buses, School Buses, and Multipurpose Passenger Vehicles (102-4, 106-8, 111-3, 116, 205-6, 209, 211)	
* /3 Cycles (3; 108, 112, 116, 205)	
/4 Design (14; 101-2, 105, 107, 201)	
/5 Door Systems (201, 206)	
/6 Fuel Systems (101, 301)	
/7 Glazing Materials (205)	
/8 Hood Latch Systems (113)	
/9 Inspection (1)	
/10 Lighting Systems (101, 105, 108, 112)	
/11 Maintenance and Repairs	
/12 Manufacturers, Distributors, and Dealers	
/13 Mirrors and Mountings (107, 111)	
/14 Occupant Protection (15; 201-4, 207-10)	
/15 Propulsion Systems	
/16 Registration (2, 10)	
/17 Safety Defect Control	
/18 Steering Control System (101, 107, 203-4)	
/19 Theft Protection (114-5)	
* /20 Trucks and Trailers (102-4, 107-8, 112-3, 116, 205-6, 209)	
/21 Used Vehicles	
/22 Wheel Systems (109-10, 211)	
/23 Windshield-Related Systems (101, 103-4, 107, 205, 212)	

NHTSA DOCUMENTS	24
EXECUTIVE SUMMARIES	27

NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brands names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval by the U. S. Department of Transportation, National Highway Traffic Safety Administration of any particular product, course, or equipment.

Harry A. Feinberg
Managing Editor

AVAILABILITY OF DOCUMENTS AND INSTRUCTIONS FOR ORDERING

Department of Transportation personnel may borrow copies of publications directly from the NHTSA. Outside the Washington, D.C. area, phone (202) 426-2768. In Washington, D.C. area, use government ID, phone 118-62768. Non-DOT personnel should contact their company or agency libraries for assistance.

Journals cited may be obtained through most research libraries.

Contractors' reports and other documents can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that retention copies will be available for more than a limited period after a document is issued.

The more common distribution sources are identified by symbols which are explained below:

NTIS: National Technical Information Service, Springfield, Va. 22151. Order by accession number: *HS, AD, or PB*. Prepayment is required by NTIS (CFSTI) coupon (GPO coupons are not acceptable), check, or money order (made payable to the NTIS), *HC* (Paper copy; full size original or

reduced facsimile) \$3.00 up; *MF* (microfiche approximately 4x6" negative sheet film; reader required) \$0.95.

GPO: Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS [CFSTI] coupons are not acceptable), check or money order (made payable to the Superintendent of Documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C. 20418.

NHTSA: National Highway Traffic Safety Administration General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874).

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report number. Prices given are list; discounts are available to members and sometimes to libraries and U.S. Government Agencies. Prepayment is required; orders without payment are subject to a \$1 handling charge.

IMPORTANT NOTICE

WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS (CFSTI), add DOT/ to the prefix HS-; example HS-800 000 should be ordered as DOT/HS-800 000.

JUNE 4, 1971

ACCIDENTS

1/0 ACCIDENTS

1/2 Injuries

HS-009 013 Fld. 1/2; 1/1

TRAUMA AT YALE

by John Robinson

Published in *Yale Alumni Magazine* v33 n5 p30-5 (Feb 1970)

The Yale Trauma Study is devoted to research on accidental injury with the goal of depriving it of its present distinction as the leading cause of death in the 1-44 year age group. Motor vehicle accidents account for some 40% of all trauma deaths, but many factors contributing to these accidents can be controlled or eliminated. The initial purpose of the study was to explore and analyze emergency treatment services in the New Haven area. Some factors dealing with emergency care are discussed.

Search terms: Emergency medical services; Fatality causes/Age factors; Accident rates; Vehicle accidents; Injury research; Accident research

HS-009 014 Fld. 1/2; 5/14

SEAT BELT INJURIES IN IMPACT

by R. G. Snyder; W. M. Crosby; C. C. Snow; J. W. Young; P. Hanson

Federal Aviation Administration, Oklahoma City, Okla., F03900

Mar 1969 29p 97 refs
Report no. AM-69-5; AD-698 289

Although the seat belt has been demonstrated to provide effective reduction of injuries and fatalities in automobile accidents by preventing ejection, a pattern of injuries directly attributable to impingement on the belt itself is becoming evident. The clinical evidence of restraint system injuries is surveyed, the gross biomechanical mechanisms of trauma are discussed, and the potential of four

types of restraint systems in producing injuries is evaluated. Results of impact tests with primates are described. The double shoulder harness with lap belt appears to offer the greatest protection while the single diagonal belt without lap belt is most dangerous.

Search terms: Seat belt caused injuries; Restraint system effectiveness/Impact tests; Primates/Impact tests; Injury factors/Restraint systems; Shoulder harnesses/Occupant protection; Seat belts/Occupant protection; Biomechanics/Injury research

AVAILABILITY: NTIS

1/3 Investigation and Records

HS-009 015 Fld. 1/3

ARIZONA'S TRAFFIC ACCIDENT SUMMARY FOR 1969

Arizona. Highway Dept., Phoenix. Traffic Safety Div., A52800

1969 36p

Accident statistics are presented for: fatalities; injuries; rural/urban; violations; vehicle characteristics; age of victims; pedestrians; drivers; time factors; school buses; and costs. In addition to the figures for 1969, tables are provided for 1925-1929 and graphs for 1960-1969.

Search terms: Accident statistics/Arizona; Accident statistics/Annual reports; Fatalities; Injuries; Urban accidents; Rural accidents; Traffic law violations; Vehicle characteristics/Accident statistics; Age factors in accidents; Pedestrian accidents; Pedestrian fatalities; Pedestrian injuries; Driver characteristics/Accident statistics; Time of day/Accident statistics; Day of week/Accident statistics; Month/Accident statistics; Highway characteristics/Accident statistics; School bus accidents; Accident costs/Arizona

HS-009 016 Fld. 1/3

CITY OF PHILADELPHIA TRAFFIC ACCIDENT FACTS. 1969

Philadelphia. Dept. of Streets, Pa., P14850

1969 38p

Cover title: Traffic Accidents. 1969. Philadelphia.

The accident statistics are reported by pedestrian, driver, and hazards. A comparison is made with the 1968 figures. Total cost places the figure in excess of \$78,000,000. A graph displays traffic accident trends for a twenty five period.

Search terms: Road conditions/Accident statistics; Road conditions/Injuries; Road conditions/Fatalities; Accident locations/Statistics; Accident causes/Statistics; Accident types/Statistics; Light conditions caused accidents; Vehicles/Accident statistics; Vehicle registration/Accident statistics; Pedestrian behavior/Accident statistics; Pedestrian behavior/Age factors; Accident statistics/Annual reports; Pedestrian accidents/Annual reports; Drivers/Accident statistics; Hazards/Accident statistics; Accident statistics/Month; Pedestrian accidents/Month; Injuries/Month; Fatalities/Month; Accident statistics/Day of week; Fatalities/Month; Accident types/Fatalities; Accident types/Injuries; Accident statistics/Time of day; Fatalities/Time of day; Traffic volume/Accident statistics; Age factors/Fatalities; Sex factors/Fatalities; Males/Fatalities; Females/Fatalities; Age factors/Injuries; Sex factors/Injuries; Males/Injuries; Females/Injuries; Pedestrian fatalities/Age factors

HS-009 017 Fld. 1/3

BRING 'EM BACK ALIVE! A STUDY OF 371 FATAL ACCIDENTS IN FLORIDA. MAY 30TH-SEPT. 2ND, 1968

1/3 Investigation and Records (Cont'd.)

HS-009 017 (Cont'd.)

by Keith Leslie; Hampton Dunn

American Automobile Assoc., Miami, Fla., A27600

1968 49p

Statistics for fatal accidents are reported by day of week, month, holidays, light conditions, weather condition, time of day, distance from home, accident type, accident location, type of roadway, age factor, sex factor, accident causes, vehicle type, distribution by county. Case histories of 13 drivers are presented. Limitations of accident reporting are pointed out. Alcohol is named as the chief cause of traffic fatalities, and a section of the report is devoted to statistics on alcohol related fatalities. Preventive measures are mentioned.

Search terms: Accident statistics/Florida; Fatalities/Day of week; Fatalities/Month; Fatalities/Holidays; Fatalities/Light; Fatalities/Weather; Fatalities/Time of day; Fatalities/Trip length; Fatalities/Accident types; Fatalities/Accident location; Alcohol chemical tests/Statistics; Fatalities/Driver intoxication; Fatalities/Road design; Fatalities/Age factors; Fatalities/Sex factors; Fatalities/Males; Fatalities/Females; Fatalities/Accident causes; Vehicle accidents/Fatalities; Driver records/Fatalities; Driver records/Accident case reports; Accident causes/Fatalities; Fatalities/Pedestrian intoxication

HS-009 018 Fld. 1/3

TRAFFIC ACCIDENT STATISTICAL SUMMARY. 1968

Pennsylvania. Dept. of Highways, Harrisburg, P04200

1969 34p

This annual report of traffic accidents includes: first object hit related to fatalities, injuries, damage, and age groups; time factors related to fatalities, injuries, and damage; statistics by county; weather conditions, surface conditions, light conditions, accident type, accident location, type of vehicle, causal factors, involved drivers, sex factors — also all related to fatalities, injuries, and damage.

Search terms: Accident statistics/Annual reports; Accident statistics/Pennsylvania; Fatalities/Annual reports; Injuries/Annual reports; Damage costs/Annual reports; Age factor in accidents; Time of day/Accident statistics; Day of week Accident statistics; Month/Accident statistics; Males/Accident statistics; Females/Accident statistics; Accident location/Statistics; Weather/Accident statistics; Road surfaces/Accident statistics; Light/Accident statistics; Accident types/Statistics; Vehicle accidents/Statistics; Accident causes/Statistics; Driver age/Accident statistics; Driver sex/Accident statistics

HS-009 019 Fld. 1/3

TRAFFIC ACCIDENTS — BACK ON THE ROAD

by Pam Jackson

Published in *Canadian Journal of Occupational Therapy* v36 p61-4 (Summer 1969)

Abstract in French.

This discussion of rehabilitation of car accident victims is limited to those suffering spinal cord injuries.

Search terms: Spinal cord injuries/Rehabilitation; Spinal cord injuries/Traffic accidents

HS-009 020 Fld. 1/3

TRAFFIC INJURY IN URBAN ENVIRONMENT

by G. M. Mackay

Birmingham Univ., Warwick (England). Dept. of Transportation and Environmental Planning, B16800

Published in *Conference on Road Safety. Vol. 1*, Brussels, 1968, pA2-1 through A2-25

5 refs

Abstracts in English, French, Dutch, German

The detailed injury mechanisms for traffic accidents in urban areas are discussed. The data presented come from a representative sample of accidents examined in Birmingham, England, using on-the-spot techniques. Injury patterns for pedestrians, motorcyclists and front seat car occupants are summarised. The origins of the injuries in relation to road and vehicle impacts are discussed for pedestrians and motorcyclists. Car occupant injuries are related to various crash configurations and interior components, and comment is made on seat belt fitting and use. The paper illustrates the importance of a detailed knowledge of injury origins in real accidents before rational and economic crash protection is incorporated into new car designs.

Search terms: Seat belt usage/Accident records; Accident types; Accident investigation; Urban accidents/Injuries; Pedestrian injuries; Motorcycle operator injuries; Motorcycle passenger injuries; Front seat passengers/Injuries; Driver injuries; Accident severity; Helmets/Injury prevention; Bumpers/Pedestrian injuries; Side windows/Pedestrian injuries; Headlamps/Pedestrian injuries; Hood caused injuries/Pedestrians; Hoods/Pedestrian injuries; Wheels/Pedestrian injuries; Windshield caused injuries/Pedestrians; Windshields/Pedestrian injuries; Grilles/Pedestrian injuries; Exterior rearview mirrors/Pedestrian injuries; Door caused injuries/Pedestrians; Doors/Pedestrian injuries; Trim/Pedestrian injuries

HS-009 021 Fld. 1/3

TRAFFIC ACCIDENTS. PT. 1

by G. E. Ridley

Published in *Highways and Traffic Engineering* v37 n1714 p36-7, 40, 42 (Jun 1969)

Accident reporting and accident statistics are presented for pedestrians, school children, crosswalks, one way systems, dual carriageways and roundabouts, and driving experience.

Search terms: Accident reports; Accident statistics; Accident investigation; Accident rates; Pedestrian accidents /Children; Pedestrian accidents /Adults; Pedestrian age /Accident statistics; Crosswalks /Accident statistics; School crossing protection; One way streets /Accident rates; Driver experience /Accident statistics; Traffic circles /Accident statistics; Divided highways /Accident statistics

HS-009 022 Fld. 1/3

TRAFFIC ACCIDENTS. PT. 2

by G. E. Ridley

Published in *Highways and Traffic Engineering* v37 n1715 p18-20 (Jul 1969)

Methods of and forms for accident reporting are discussed.

Search terms: Accident rates /Accuracy; Accident report forms /Uniformity; Accident investigation /Planning

HS-009 023 Fld. 1/3

ACCIDENT FACTS

National Safety Council, Chicago, Ill., N25200

1970 99p

Accident statistics for 1969 are divided into various categories: all accidents; work; motor vehicle; public; home; farm; and school.

Search terms: Accident statistics; Vehicle accidents /Accident statistics; Industrial accidents /Accident statistics; Farm vehicle accidents /Accident statistics; Accident rates; Injury rates; Children /Accident statistics; School bus accidents /Accident statistics; Accident causes; Accident types; Accident factors; Accident costs

HS-009 024 Fld. 1/3

ROAD ACCIDENTS

by Chandra P. De Fonseca

Published in *Manchester Medical Gazette* v48 p19-21 (Jul 1969)

Road accidents are the greatest accident problem in Great Britain. Aspects of the problem discussed are the changing pattern of injuries; the importance of non-fatal injuries, especially those which are severe and disabling; accident and injury prevention.

Search terms: Accident rates /Great Britain; Injury rates /Great Britain; Injury severity; Accident prevention; Injury prevention

HS-009 025 Fld. 1/3

KANSAS INTERSTATE SYSTEM ACCIDENT RESEARCH STUDY, 1964-1965-1966-1967-1968

Kansas, Highway Commission, Topeka, K01200

1969 11p

It is important that accident involvement data on the Interstate System be analyzed on a continuing basis in order to confirm the safety benefits expected to

be derived and to help create a safer and more modern expressway design for the future. Accident, injury, and fatality rates are analyzed for sections of the Interstate System. Accident types, locations, causes are included. Most of the data deals with 1968 accidents but some deals with five years.

Search terms: Accident rates /Interstate Highway System; Injury rates /Interstate Highway System; Fatality rates /Interstate Highway System; Accident types /Interstate Highway System; Accident location /Interstate Highway System; Accident causes /Interstate Highway System; Accident studies /Interstate Highway System; Accident research /Interstate Highway System; Accident statistics /Kansas; Accident statistics /Interstate Highway System

HS-009 026 Fld. 1/3; 3/11; 3/3;

THE CHILD IN DETROIT TRAFFIC. 1969. ANALYSIS OF CHILD TRAFFIC ACCIDENTS

by John Logan

Detroit. Police Dept., Mich. Traffic Safety Bureau, D18100

1969 14p

Major causes of traffic injuries and deaths to children ages 0-14 are reported. Data are presented for pedestrians, passengers, and bike riders. Time factors and accident location also are included.

Search terms: Child injuries /Statistics; Children /Fatalities; Pedestrian injuries /Children; Pedestrian accidents /Children; Pedestrian fatalities /Children; Bicycle accidents /Children; Bicycle rider age /Accidents; Bicycle rider fatalities /Children; Bicycle rider injuries /Children; Passenger fatalities /Children; Passenger injuries /Children; Accident location /Children; Time of day /Accidents; Day of week /Accidents; Month /Accidents

1/4 Locations

HS-009 027 Fld. 1/4; 2/4; 2/9

RESEARCH ON ACCIDENTS AT ROAD JUNCTIONS

by C. R. Faulkner

England. Road Research Lab., Crowthorne, Berks., E14400

8p 10 refs

Presented to Institution of Highway Engineers, Norwich, England, 15 Jan 1969. Reprinted from *Journal of the Institution of Highway Engineers* v16 n12 (Dec 1969).

About half the serious accidents in Britain occur at junctions. Estimates of vehicle mileages and casualties indicate that overall accident rates are higher at rural than at urban junctions. Systematic collection of accident debris indicates that collisions causing only minor damage are up to ten times greater than the number of injury accidents. A review is given of established methods for improving at-grade junction layout. The most effective involve disturbance to the main road traffic flows. Interest is concentrated in the study of repeating factors in clusters of accidents at individual sites. Ideas for research include the layout of give-way lines and acceleration lanes, visual warnings, and reducing the speeds of the fastest vehicles through junctions.

Search terms: Intersections /Accident location; Intersections /Accident rates; Intersections /Urban accidents; Intersections /Rural accidents; Debris /Accident research; Highway design /Intersections; Highway improvements /Accident location; Acceleration lanes; High speed /Intersections; Warning systems /Intersections; Right of way (traffic rules); Accident rates /Great Britain; Accident severity /Intersections

2/0 HIGHWAY SAFETY

HS-009 028 Fld. 2/0; 3/1; 1/3

THE "UNDERWRITER" COLUMNS ON HIGHWAY LOSS REDUCTION

by William Haddon, Jr.; Albert Benjamin Kelley

Insurance Inst. for Highway Safety, Washington, D.C., I36600

Apr 1970 30p

Reprint of five articles from *National Underwriter*, Sep 1969-Jan 1970.

This discussion of highway safety includes five aspects: strategies for cutting highway losses, such as accident prevention, occupant protection, and post-accident aid; covering the crash, emphasizing a three-phase approach; speed does kill; detecting drunk drivers through pre-arrest testing; supercars and crash losses.

Search terms: Accident prevention; Occupant protection; Emergency medical services; Precrash phase; Crash phase; Postcrash phase; High speed caused accidents; High powered automobiles /Accident factors; Alcohol breath tests /Arrests; Drinking drivers /Alcohol breath tests

AVAILABILITY: Corporate author

2/4 Design and Construction

HS-009 029 Fld. 2/4

AN APPRAISAL OF THE CURRENT HIGHWAY SITUATION IN ILLINOIS

by W. Robert Blair

Illinois. General Assembly, Springfield, I09750

1968 15p

Presented at Illinois Highway Engineering Conference, Univ. of Illinois, Urbana, 28 Feb 1968.

The history of the Illinois Highway Study Commission is discussed, its appraisal of the highway situation given, and its current work described. The needs of the state in additional road mileage or improvements to existing highways and the costs and revenues involving these needs are described.

Search terms: Highway transportation /Illinois; Highway improvements /Illinois; Highway planning /Illinois; Highway costs /Illinois; Mileage /Illinois; Revenue /Highways

HS-009 030 Fld. 2/4

THE EFFECTS OF DE-ICING SALTS AND STUDDED TIRES ON ASPHALT PAVEMENT WEARING SURFACES

by G. Zichner

10p

De-icing salts and studded tires have considerably adverse effects on road pavements. The de-icing salts keep the pavements wet longer than usual and the studded tires loosen the near-surface material. This material is finally broken out of the pavement by traffic which now exerts an abrasive action on the pavement. The surfaces become rough and open-textured. In the warm season, the kneading action of traffic may, however, close these open-textured surfaces. Winter damages have also been experienced on roads complying with the specifications or standards. Investigations have shown that rutting of 5 mm (1/5 in.) is very likely to occur on asphalt concrete pavements in the winter under medium to heavy traffic. Guss asphalt generally shows less wear.

Search terms: Asphalt pavements /Ice removal; Asphalt pavements /Studded tires; Pavement wear /Ice removal; Pavement wear /Studded tires; Tire chains /Asphalt pavements; Tire chains /Pavement wear; Snow tires /Asphalt pavements; Snow tires /Pavement wear

AVAILABILITY: Mr. Paul Fluss,

1661 Albemarle Way, Burlingame, Calif., 94010 \$2

HS-009 031 Fld. 2/4

THE CURRENT STATUS OF GUARDRAIL STANDARDIZATION

by Richard A. Richter

Published in *Highway Focus* v2 n1 p14-20 (Feb 1970)

Standardization of guardrail components can serve to lower the cost of such installations as well as increase the reliability of the functional service they provide. States have, through contact with each other, developed designs for various features similar to each other but with many insignificant variations in details. Through the efforts of an American Association of State Highway Officials-American Road Builders Joint Committee Task Force, and based on a survey of states' designs practices, a design guide for guardrail fabrication details is being prepared in the hopes of increasing standardization and safety. This paper is devoted almost entirely to engineering drawings of the structural components being used in various states.

Search terms: Guardrail design /Standardization; Guardrail design /State planning; Guardrail design /Engineering drawings; Guardrail design /Benefit cost analysis

HS-009 032 Fld. 2/4

SKIDDING RESEARCH IN GREAT BRITAIN AND ITS EFFECT ON MATERIALS REQUIREMENTS

by G. F. Salt

Published in *Journal of the British Granite and Whinstone Federation* v9 n1 8p (Spring 1969)

Reprint

The relationship between road surface materials and skidding accidents is reviewed, as is the relationship of polishing of aggregates and resistance to skidding.

Search terms: Skid resistance tests /Great Britain; Pavement surface texture /Skid resistance; Skidding accidents /Coefficient of friction; Aggregates /Polishing; Stones /Polishing; Pavement tests /Polishing; Pavement skidding characteristics; Surface friction; Surface roughness; Chips

HS-009 033 Fld. 2/4; 1/3

INTERSECTIONS

Box (Paul C.) and Associates, Skokie, Ill., B240000

1970 14p 98 refs

Ch. 4 of TRAFFIC CONTROL & ROADWAY ELEMENTS - THEIR RELATIONSHIP TO HIGHWAY SAFETY. REVISED.

Intersection elements which can be related to intersection accident rates include geometric layout and traffic controls. These elements are discussed and related to geometric layout and left turns and to the following aspects of traffic control: yield signs, two way stop control, four way stops, traffic signals, signal modernization and operation, flashing beacons, and directional signing. Many of these aspects are also related to accident rates.

Search terms: Intersections /Traffic control; Intersections /Accident rates; Yield signs; Two way stop intersections; Four way stop intersections; Traffic signals; Traffic signal modernization; Direction signs; Flashing traffic signals

2/5 Lighting

HS-009 034 Fld. 2/5

A BETTER WAY... LIGHTING FOR HIGH SPEED, MULTILANE HIGHWAYS

by Donald E. Husby; Richard E. Stark

Published in *Illuminating Engineering* v65 n3 p156-62 (Mar 1970)

Presented at National Technical Conference of Illuminating Engineering Society, Boston, Mass., 25-29 Aug 1969.

Highway lighting is predicated on designs formulated a generation ago, providing good roadways for daylight motoring. Hardly any effort of specific concern has been exercised towards improving nighttime driving or greater nighttime highway safety. The lighting industry has dealt with new problems by using presently available luminaries with little or no modification. A more definitive method of measuring and applying lighting for multilane high speed expressways is needed. Some form of vertical illumination appraisal should be available. A method is suggested, and diagrams of isocandela and vertical and horizontal footcandles are included.

Search terms: Highway lighting /High speed highways; Lighting measurement /Highway lighting; Lighting design /High speed highways; Lighting equipment /High speed highways; Highway safety /Night driving; Luminaires /Lighting design

2/7 Meteorological Conditions

HS-009 035 Fld. 2/7; 5/6; 3/8

HEALTH EFFECTS OF AIR POLLUTION

Anonymous

Published in *World Health Organization Chronicle* v23 p264-74 (Jun 1969)

A symposium on the health effects of air pollution, convened by WHO, was held in Prague on 6-10 November 1967 for the purpose of reviewing progress in the field in Europe. Also considered were the lines along which future research might be conducted and what further progress might be made toward drawing up

2/7 Meteorological Conditions (Cont'd.)

HS-009 035 (Cont'd.)

criteria, guides, and standards of air quality. Epidemiology and the effects of air pollution on health are discussed in this report. Bronchitis and lung cancer are mentioned in the morbidity investigations. Carbon monoxide studies are reviewed in relation to motor vehicle exhaust gases.

Search terms: Air pollution effects on health /Conferences; Air pollution effects on health /Europe; Air quality standards; Air pollution effects on health /Epidemiology; Air pollution effects on health /Neoplasms; Air pollution effects on health /Bronchitis; Carbon monoxide /Exhaust emissions measurement

2/9 Traffic Control

HS-009 036 Fld. 2/9

ON THE FLOW CAPACITY OF AUTOMATED HIGHWAYS

by J. G. Bender; R. E. Fenton

Published in *Transportation Science* v4 n1 p52-63 (Feb 1970)

7 refs

Virtually all proposed systems for highway automation have at least one mode in common—steady state car following. The nature of this mode is extremely important, as it can determine the upper limit of flow capacity of an automated highway. This limit is explored for a linear headway controller, and a fundamental relation between the effective vehicle response time and the permissible traffic stream density is obtained. The required intervehicular spacing with a linear headway controller is shown to be proportional to the effective vehicle time constant for small signal inputs; thus one can achieve small spacings and high flow rates by reducing this parameter to 1 second or less. However, the vehicle is then highly responsive to small changes

in lead vehicle speed, possibly resulting in passenger discomfort and poor fuel economy. These shortcomings can be avoided by using a linear velocity controller for automatic car following.

Search terms: Car following /Steady state; Automatic headway control; Automatic highways /Traffic flow; Reaction time /Traffic density; Traffic flow /Time headways; Automatic highways /Traffic capacity; Vehicle spacing /Automatic highways; Vehicle spacing /Automatic headway control

HS-009 037 Fld. 2/9

ERGS. ELECTRONIC ROUTE GUIDANCE SYSTEM

Bureau of Public Roads, Washington, D. C. B33600

Apr 1969 12p

The Electronic Route Guidance System is described. As it exists today, the system is a closed loop, individualized, integrated highway/vehicle communication system. It has been tested successfully on a small scale and is undergoing further work at the present time. Future developments and their application as well as estimated costs are presented.

Search terms: Electronic route guidance system; Electronic route guidance system /Trip geography; Electronic route guidance system /Traffic generation; Electronic route guidance system /Costs

HS-009 038 Fld. 2/9

PAINT STRIPE AND GLASS BEAD STUDY. FIELD TEST SECTIONS, REPORT 1

by George A. McCaskill; Carl F. Crumpton

Kansas. Highway Commission, Topeka, K01200

1969 62p

Report no. PB-185 072

In cooperation with the U.S. Bureau of Public Roads.

Tests were made of individual centerline stripes, continuous edgelines, and beads. At the end of one year 99% of the stripes were performing satisfactorily. Some stripes on asphalt were nearly two years old and still satisfactory. The tests demonstrated that thinner paint stripes and lower bead application rates than commonly recommended can be utilized. Paint thickness can be reduced to ten mils and bead rate to four pounds per gallon. A better reflecting, faster drying, more durable stripe will result. In Kansas paint chipping is the major problem of paint loss. Wear or abrasion is a minor problem. There is also minor loss due to snowplow operations, patching, crack filler, and joint compound. The service life of the paint stripes is often more dependent upon the surface conditions of the road than upon the thickness of the paint film.

Search terms: Pavement edge markings /Performance tests; Pavement markings /Performance tests; Glass beads /Performance tests; Paints /Performance tests; Paints /Service life; Highway maintenance /Pavement markings; Pavement markings /Damage

AVAILABILITY: NTIS

HS-009 039 Fld. 2/9

HIGHWAY SPEED STUDY

Connecticut. Highway Dept., Wethersfield, C58200

May 1970 59p

This study is based on the speeds of 2,600 vehicles observed at 13 permanent stations located throughout Connecticut and provides a cross section of various driver-vehicle characteristics on four general highway types. The average speed of all vehicles in this study is 49.3 mph, an increase of 0.9 mph since May 1969. Comparison of average speeds for all vehicles is given for four-lane undivided highways and four-lane divided highways, both with intersections at grade; for four-lane divided highways

with grade separations; and for two-lane, two-way highways with intersections at grade. The speed patterns of male and female drivers are also compared.

Search terms: Highway characteristics /Speed studies; Speed studies /Connecticut; Speed patterns /Male drivers; Speed patterns /Female drivers; Two lane highways /Speed patterns; Divided highways /Speed patterns; Speed studies /Statistics

HS-009 040 Fld. 2/9; 2/2

SYMPOSIUM ON MOTORIST-AID SYSTEMS, WASHINGTON, D. C., JANUARY 18, 1968. SUBJECT CLASSIFICATION. TRAFFIC CONTROL AND OPERATION.

Highway Research Board, Washington, D. C., H09600

Published in *Highway Research Circular* n84 p1-22 (Oct 1968)

142 refs

Report on Committee Activity of the Special Committee on Electronic Research in the Highway Field (SC-3). Symposium took place at the 47th Annual meeting of the Highway Research Board.

A panel discussion of motorist aid systems including emergency communications is presented.

Search terms: Driver aid systems /Electronic devices; Driver aid systems /Conferences; Traffic control; Driver aid systems /Planning; Driver aid systems /Research methods; Disabled vehicles /Research methods; Driver aid systems /Telephones; Driver aid, information, and routing system; Emergency reporting systems; Emergencies /Radiotelephones; Citizens band radios /Emergencies; Radios /Emergencies; Emergency signalling devices; Police traffic services /Emergencies; Communications /Bibliographies; Driver aid sys-

tems /Bibliographies; Emergency reporting systems /Bibliographies; Radiotelephones /Bibliographies; Radios /Bibliographies; Telephones /Bibliographies; Television /Bibliographies

HS-009 041 Fld. 2/9; 4/1

ILLUSTRATIVE STATE STATUTORY MATERIALS RELATING TO THE OPERATION OF MOTOR VEHICLES AT RAILROAD GRADE CROSSINGS WITH COMMENTS BASED ON A COMPARATIVE STUDY OF ALL STATE STATUTES ON SAME SUBJECT MATTER. FINAL REPORT

by Charles H. Bowman

Illinois Univ., Urbana. Highway Traffic Safety Center, I16800

1965 65p

Reprinted 1969

From this comparative study of laws of each of the various states which relate to the operation of motor vehicles at railroad grade crossings, it was concluded that there is not now in effect in any state, a modern integrated statute which adequately provides for all currently known safeguards for the safety of motor vehicles at railroad grade crossings; that the fragmented and out dated ad hoc statutes now in effect in practically all states cannot supply the basis for maximum effective regulation and control of conditions necessary to the safety of the motoring public at railroad grade crossings; that an integrated statute dealing with all controllable aspects of motor vehicle safety at the crossing must be adopted in each state. Such a statute may and should include enabling provisions for the exercise of administrative agency functions in appropriate areas. An index to state laws is provided.

Search terms: Railroad grade crossings /State laws; State laws /Indexes; Railroad grade crossing lighting; Rail-

road grade crossing signals; Railroad grade crossing signs; Railroad grade crossings /Law enforcement; Railroad grade crossing /Audio warning devices; Automatic railroad grade crossing gates; Automatic warning systems /Railroad grade crossings; Railroad grade crossing /Uniform Vehicle Code

3/0 HUMAN FACTORS

3/1 Alcohol

HS-009 042 Fld. 3/1; 4/1

DETECTION AND SANCTIONS OF THE STATE OF INTOXICATION IN DRIVERS (DETECTION ET SANCTIONS DE L'ETAT ALCOOLIQUE DES CONDUCTEURS)

by A. Chosalland

Published in *International Police Chronicle* v18 n100 p18-24 (Jan-Feb)

Results of a survey of twenty countries regarding methods of identifying the intoxicated driver and the penalties invoked are reported. A plea is made for standardization of laws and uniformity of enforcement on an international basis; for a big world campaign for public information; and to warn drivers regarding the synergistic effects of alcohol with other drugs.

Search terms: Driver intoxication /Surveys; Alcohol laws /International factors; Alcohol laws /Standardization; Law uniformity /Alcoholic beverages; Law enforcement /Uniformity; Public information programs /Driver intoxication; Drug effects; Synergism; Blood alcohol levels /International factors; Alcohol blood tests /International factors; Alcohol chemical tests /International factors; Alcohol breath tests /International factors; Alcohol test refusal /International factors

3/2 Anthropomorphic Data

HS-009 043 Fld. 3/2; 5/4

ANTHROPOMETRY AND VEHICLE CONSTRUCTION—A BRIEF SURVEY

by E. Fiala

Freie Univ. Berlin (West Germany), F25790

Published in *1970 International Automobile Safety Conference Compendium* (P-30), New York, 1970, p52-6

9 refs

Report no. SAE-700357

Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

Problems in anthropometry are discussed, including measurements of the human body, mobility of the joints, comfortable positions, accessibility of controls, minimal space for survival after impact, impact targets in the car during an accident.

Search terms: Anthropometry /Automobile design; Human body size; Human factors engineering; Secondary collisions; Comfort; Control location; Crashworthiness /Survival; Ergosphere

AVAILABILITY: SAE; also in HS-007 859

3/4 Driver Behavior

HS-009 044 Fld. 3/4

ACCIDENTS, TRAFFIC LAW VIOLATIONS AND COMMUNICATION METHODS TO CHANGE DRIVER BEHAVIOR. A LITERATURE REVIEW WITH SELECTED ABSTRACTS, BIBLIOGRAPHY AND LISTING OF RESEARCH IN PROGRESS

by Allan Katz

Technion Research and Development Foundation Ltd., Haifa (Israel). Road

Safety Centre, T07050

Aug 1968 64p 117 refs
Report no. 68/1

Results of the literature review indicate: 1) studies of large groups of drivers show the correlation of accidents to violations during a concurrent period to be approximately 0.25; 2) communications used in driver improvement programs reduce violation but not accident rates; 3) since violations and accidents have causes other than bad driver attitude, and driver improvement communications are devoted to attitude alteration, they are ineffective; 4) to reduce accidents, driver communications should include information to aid the driver in his task; 5) the ergonomic approach to study of drivers problems rather than problem drivers has become the dominant form of driving behavior studies. Summaries or abstracts are quoted for 24 items from the bibliography.

Search terms: Accident research /Reviews; Accident factors /Traffic law violations; Driver improvement /Reviews; Driver behavior research /Reviews; Accident research /Reviews; Traffic law violations /Accident risk forecasting; Driver attitudes /Driver improvement schools; Human factors engineering /Driver behavior research; Accident research /Bibliographies; Driver behavior research /Bibliographies; Safety propaganda /Bibliographies; Driver skills /Bibliographies

HS-009 045 Fld. 3/4; 3/5

FOLLOW-UP EVALUATION OF THE PERFORMANCE OF DRIVER IMPROVEMENT CLASSES FOR PROBLEM DRIVERS

by Donald H. Schuster

Published in *Journal of Safety Research* v1 n2 p80-7 (Jun 1969)

9 refs

This study evaluated the effectiveness of a Driver Improvement Class in California

by comparing subsequent driving records of drivers who had attended class vs. those who hadn't. All drivers had a one hour improvement interview with the Department of Motor Vehicles. Drivers voluntarily attended the class, but the resulting possible volunteer bias was controlled in the analyses of covariance for the follow-up driving records as well as by matching drivers in the analysis groups on relevant characteristics. In general, the problem drivers cut their previous moving violations and driving accidents about in half in the follow-up period regardless of class, but yet were worse than the average California driver. Whether using raw data or data from matched groups, the follow-up driving record of drivers who had attended the 18-hour class was comparable (no better, no worse) in general to that of drivers who had had the 1-hour interview alone. The influence of variables such as license restriction and years of driving were considered and suggestions made as to the type of driver who would benefit by driver improvement classes. Recommendations were also made for future research.

Search terms: Psychotherapy /Driver improvement; Group dynamics /Driver improvement; Driver records; Driver interviews; Problem drivers; Driver improvement measurement; Driver improvement schools

HS-009 046 Fld. 3/4; 3/5

THE OTHER GUY'S SPEED

by Paul W. Kearney

Aspects of accurate recognition of speed differential are discussed. Methods of ascertaining the speed of the lead car are described. Red taillights are perceived as being farther away than they really are. Trees, utility poles, and fences have been moved back from the traffic lanes, a precaution which has robbed the driver of all the things that gave him a good idea of how fast he was going. Reliance on the speedometer is emphasized. Rear end accidents attributed to faulty judgment of speed differential are described. Training in this skill is recommended for

driver education courses. Radar is suggested as a teaching tool.

Search terms: Speed differential /Red lamps; Speed differential /Roadside hazards; Speed differential /Speedometers; Speed differential /Rear end collisions; Speed differential /Driver education; Speed differential /Radar

HS-009 047 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 1, SUMMARY REPORT

by Eugene Farber; Arno Cassel; Raymond E. Reilly; Bernard J. Cameron; David H. Weir; Frederic R. Alex; Robert F. Ringland

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; BioTechnology, Inc., Arlington, Va., B13800; Systems Technology, Inc., Hawthorne, Calif., S63600

May 1969 57p
Contract FH-11-6145
Report no. TR-1-218-Vol-1; PB-184 955

Subcontracted to BioTechnology, Inc. and Systems Technology, Inc. Vol. 1 of 4.

A study to define the requirements of overtaking and passing maneuvers on two-lane rural roads in terms of both driver judgment and control processes under adverse visibility conditions is summarized. The goals and objectives of the program are discussed, and their relation to the technical approaches adopted by the investigators is described. Conclusions and recommendations are presented and the supporting research is summarized.

Search terms: Passing /Reduced visibility; Overtaking /Reduced visibility; Driver behavior /Decision making; Passing /Two lane roads; Passing /Rural roads; Passing /Vehicle control; Passing /Driver performance; Driver behavior research; Passing /Mathematical models;

Passing /Road tests; Passing /Day vs night performance; Passing /Judgment

AVAILABILITY: NTIS

HS-009 048 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 2, DRIVER JUDGMENT AND DECISION-MAKING IN ACCELERATIVE PASSING SITUATIONS ON TWO-LANE RURAL HIGHWAYS

by Eugene Farber

Franklin Inst. Research Labs., Philadelphia, Pa., F24000

May 1969 190p 34 refs
Contract FH-11-6145
Report no. TR-1-218-Vol-2; PB-184 956

Vol. 2 of 4.

The general experimental approach to the accelerative passes study is discussed, and the results of five experiments are presented. Three experiments dealt with driver judgment: the first measured distance judgment to an oncoming car, night and day; the second measured velocity judgment of an oncoming car at night; the third was an over-the-road study of sight distance judgment on rural roads under various visibility conditions. Two experiments dealt with passing behavior in actual traffic. It was concluded that drivers are poor judges of passing situations and that both speed and distance judgment errors contribute to erroneous passing decisions. Recommendations include: equipping vehicles with a real time display of lead-car - oncoming-car time separation, incorporating a warning signal for hazardously short situations; making headlight separation standard on all vehicles so that distance judgment based on visual angle will be improved; and installation of signs near the end of no passing zones giving information on the distance to the next passing zone.

Search terms: Passing /Reduced visi-

bility; Overtaking /Reduced visibility; Passing /Two lane roads; Passing /Rural roads; Passing /Day vs night performance; Oncoming vehicles /Distance perception; Vehicle characteristics /Passing; Distance perception /Day vs night performance; Velocity perception /Oncoming vehicles; Velocity perception /Night driving; Driver behavior research /Day vs night performance; Sight distances /Reduced visibility; Driver behavior research /Passing; Passing /Road tests; Decision making /Passing; Passing aid systems; Reduced visibility /Accident factors; Road tests /Instrumentation; Passing /Judgment

AVAILABILITY: NTIS

HS-009 049 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 3, DRIVER JUDGMENT AND DECISION-MAKING IN OVERTAKING AND FLYING PASS SITUATIONS

by Raymond E. Reilly; Bernard J. Cameron

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; BioTechnology, Inc., Arlington, Va., B13800

May 1969 162p 12 refs
Contract FH-11-6145
Report no. TR-1-218-Vol-3; PB-184 957

Subcontracted to BioTechnology, Inc. Vol. 3 of 4.

Seven controlled field experiments were organized in two phases: the first dealt with the relationship between visual cues from the tail of a lead vehicle and the distances at which a driver could detect closing, and at which he decelerated to maintain proper headway; the second dealt with the flying pass limited by oncoming vehicle. Elements studied in phase 1 included: various visual displays on the lead vehicle, relative display effectiveness in dark and daylight, and effects of informing drivers of the width

3/4 Driver Behavior (Cont'd.)**HS-009 049 (Cont'd.)**

of the lead vehicle display. Phase 2 investigated: time, speed, and distance parameters in dark and daylight; speed displays mounted on the oncoming vehicle; stationary reference objects in the driver's forward field of view; and driver's perception of motion in the opposing vehicle. Results and recommendations include: distance judgment based on rear display varied in dark and daylight; taillight displays should be standardized; and highway illumination might improve driver performance more than optimal taillight display.

Search terms: Passing/Reduced visibility; Overtaking/Reduced visibility; Driver behavior/Decision making; Passing/Two lane roads; Passing/Rural roads; Rear lamps/Sight distances; Passing/Oncoming vehicles; Passing/Day vs night performance; Passing aid systems; Motion perception/Oncoming vehicles; Distance perception/Rear lamps; Rear lamps/Standardization; Passing/Road tests; Overtaking/Deceleration; Driver behavior research; Passing/Highway design; Passing/Judgment

AVAILABILITY: NTIS

HS-009 050 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 4, DRIVER CONTROL DURING OVERTAKING AND PASSING

by David H. Weir; Frederic R. Alex; Robert F. Ringland

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; Systems Technology, Inc., Hawthorne, Calif., S63600

May 1969 155p 31 refs

Contract FH-11-6145

Report no. TR-1-218-Vol-4; PB-184 958

Subcontracted to Systems Tech-

nology, Inc. Vol. 4 of 4.

Analytical and experimental results showing the effects of adverse perceptual and roadway conditions on driver steering response and performance are presented. Analytical methods employed a dynamic model featuring a closed-loop structure of vehicle, driver response, and roadway/environment. Adverse conditions considered separately were: crowned roads, wet roads, night driving, rear end loading, and low tire pressure. Experiments used an instrumented station wagon to validate the driver/vehicle/roadway model and explore effects of adverse conditions on passing performance. Driver steering control was found to deteriorate in high speed passes when an oncoming vehicle is present, and under degraded perceptual and environmental conditions. Recommendations for improving performance in overtaking and passing maneuvers included: improving the roadway, standardizing markings and passing zones, improving vehicle design and operation, and driver training in passing tasks.

Search terms: Passing/Reduced visibility; Overtaking/Reduced visibility; Passing/Two lane roads; Passing/Rural roads; Passing/Vehicle control; Passing/Driver performance; Driver vehicle road interfaces/Mathematical models; Passing/Road crowns; Passing/Wet road conditions; Passing/Night driving; Passing/Rear end loading; Passing/Tire inflation pressure; Passing/Instrumented vehicles; Passing/Road tests; Passing aid systems; Passing/Judgment

AVAILABILITY: NTIS

HS-009 051 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 1, SUMMARY REPORT

by Eugene Farber; Arno Cassel; Raymond E. Reilly; Bernard J. Cameron; David H. Weir; Frederic R. Alex; Robert F. Ringland

Franklin Inst. Research Labs., Philadelphia, Pa., F24000; BioTechnology, Inc., Arlington, Va., B13800; Systems Technology, Inc., Hawthorne, Calif., S63600

Jan 1970 57p

Contract FH-11-6145

Report no. TR-1-218-Vol-1

Subcontracted to BioTechnology, Inc., and Systems Technology, Inc. A Bureau of Public Roads reissue of vol. 1 of the contractor's report, dated May 1969. Vol. 1 of 4.

A study to define the requirements of overtaking and passing maneuvers on two-lane rural roads in terms of both driver judgment and control processes under adverse visibility conditions is summarized. The goals and objectives of the program are discussed, and their relation to the technical approaches adopted by the investigators is described. Conclusions and recommendations are presented and the supporting research is summarized.

Search terms: Passing/Reduced visibility; Overtaking/Reduced visibility; Driver behavior/Decision making; Passing/Two lane roads; Passing/Rural roads; Passing/Vehicle control; Passing/Driver performance; Driver behavior research; Passing/Mathematical models; Passing/Road tests; Passing/Day vs night performance; Passing/Judgment

HS-009 052 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 2, DRIVER JUDGMENT AND DECISION-MAKING IN ACCELERATIVE PASSING SITUATIONS ON TWO-LANE RURAL HIGHWAYS

by Eugene Farber

Franklin Inst. Research Labs., Philadelphia, Pa., F24000

Jan 1970 190p 34 refs

Contract FH-11-6145

Report no. TR-1-218-Vol-2

JUNE 4, 1971

HUMAN FACTORS

A Bureau of Public Roads reissue of Vol. 2 of the contractor's report, dated May 1969. Vol. 2 of 4.

The general experimental approach to the accelerative passes study is discussed, and the results of five experiments are presented. Three experiments dealt with driver judgment: the first measured distance judgment to an oncoming car, night and day; the second measured velocity judgment of an oncoming car at night; the third was an over-the-road study of sight distance judgment on rural roads under various visibility conditions. Two experiments dealt with passing behavior in actual traffic. It was concluded that drivers are poor judges of passing situations and that both speed and distance judgment errors contribute to erroneous passing decisions. Recommendations include: equipping vehicles with a real time display of lead-car/oncoming-car time separation, incorporating a warning signal for dangerous situations; making headlight separation standard on all vehicles, so that distance judgment based on visual angle will be improved; and installation of signs near the end of no passing zones giving the distance to the next passing zone.

Search terms: Passing/Reduced visibility; Overtaking/Reduced visibility; Passing/Two lane roads; Passing/Rural roads; Passing/Day vs night performance; Oncoming vehicles/Distance perception; Vehicle characteristics/Passing; Distance perception/Day vs night performance; Velocity perception/Oncoming vehicles; Velocity perception/Night driving; Driver behavior research/Day vs night performance; Sight distances/Reduced visibility; Driver behavior research/Passing; Passing/Road tests; Decision making/Passing; Passing aid systems; Reduced visibility/Accident factors; Road tests/Instrumentation; Passing/Judgment

HS-009 053 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 3, DRIVER JUDGMENT AND DECISION-MAKING IN OVERTAKING AND FLYING PASS SITUATIONS

SION-MAKING IN OVERTAKING AND FLYING PASS SITUATIONS

by Raymond E. Reilly; Bernard J. Cameron

Franklin Inst. Research Labs., Philadelphia, Pa., F240000; BioTechnology, Inc., Arlington, Va., B138000

Jan 1970 162p 12 refs
Contract FH-11-6145
Report no. TR-1-218-Vol-3

Subcontracted to BioTechnology, Inc. A Bureau of Public Roads reissue of Vol. 3 of the contractor's report, dated May 1969. Vol. 3 of 4.

Seven controlled field experiments were organized in two phases: the first dealt with the relationship between visual cues from the tail of a lead vehicle and the distances at which a driver could detect closing, and at which he decelerated to maintain proper headway; the second dealt with the flying pass limited by oncoming vehicle. Elements studied in phase 1 included: various visual displays on the lead vehicle, relative display effectiveness in dark and daylight, and effects of informing drivers of the width of the lead vehicle display. Phase 2 investigated: time, speed, and distance parameters in dark and daylight; speed displays mounted on the oncoming vehicle; stationary reference objects in the driver's forward field of view; and driver's perception of motion in the opposing vehicle. Results and recommendations include: distance judgment based on rear display varies in dark and daylight; taillight displays should be standardized; and highway illumination might improve driver performance more than optimal taillight display.

Search terms: Passing/Reduced visibility; Overtaking/Reduced visibility; Driver behavior/Decision making; Passing/Two lane roads; Passing/Rural roads; Rear lamps/Sight distances; Passing/Oncoming vehicles; Passing/Day vs night performance; Passing aid systems; Motion perception/Oncoming vehicles; Distance

perception/Rear lamps; Rear lamps/Standardization; Passing/Road tests; Overtaking/Deceleration; Driver behavior research; Passing/Highway design; Passing/Judgment

HS-009 054 Fld. 3/4; 3/8

OVERTAKING AND PASSING UNDER ADVERSE VISIBILITY CONDITIONS. VOL. 4, DRIVER CONTROL DURING OVERTAKING AND PASSING

by David H. Weir; Frederic R. Alex; Robert F. Ringland

Franklin Inst. Research Labs., Philadelphia, Pa., F240000; Systems Technology, Inc., Hawthorne, Calif., S636000

Jan 1970 146p 31 refs
Contract FH-11-6145
Report no. TR-1-218-Vol-4

Subcontracted to Systems Technology, Inc. A Bureau of Public Roads reissue of Vol. 4 of the contractor's report, dated May 1969. Vol. 4 of 4.

Analytical and experimental results showing the effects of adverse perceptual and roadway conditions on driver steering response and performance are presented. Analytical methods employed a dynamic model featuring a closed-loop structure of vehicle, driver response, and roadway/environment. Adverse conditions considered separately were: crowned roads, wet roads, night driving, rear end loading, and low tire pressure. Experiments used an instrumented station wagon to validate the driver/vehicle/roadway model and explore effects of adverse conditions on passing performance. Driver steering control was found to deteriorate in high speed passes when an oncoming vehicle is present, and under degraded perceptual and environmental conditions. Recommendations for improving performance in overtaking and passing maneuvers included: improving the roadway, standardizing markings and passing zones, improving vehicle design and operation, and driver training in passing tasks.

3/4 Driver Behavior (Cont'd.)**HS-009 054 (Cont'd.)**

Search terms: Passing/Reduced visibility; Overtaking/Reduced visibility; Passing/Two lane roads; Passing/Rural roads; Passing/Vehicle control; Passing/Driver performance; Driver vehicle road interfaces/Mathematical models; Passing/Road crowns; Passing/Wet road conditions; Passing/Night driving; Passing/Rear end loading; Passing/Tire inflation pressure; Passing/Instrumented vehicles; Passing/Road tests; Passing aid systems; Passing/Judgment

3/5 Driver Education**HS-009 055 Fld. 3/5****DRIVER AND HIGHWAY TRAFFIC SAFETY EDUCATION**

by J. Brian Boulton

National Safety Council of Western Australia, Mt. Lawley, (Australia), N27900

Aug 1969 363p

Driver and traffic safety education efforts in the United States, United Kingdom, and Australia are summarized.

Search terms: Driver education standards/United States; Driver education/History; Driver education costs; Driver education/Financing; Instructors; Instruction materials; Curricula; Driver education/Management; Driver education/New York; Driver education/Michigan; Driver education/Illinois; Driver education/Industries; Driver education/California; Driver education/Connecticut; Driver education/Canada; Commercial driver training; Commercial driving schools; Driver education/Manuals; Driver education/Associations; Driver education/Government; Driver education/Colleges; High school driving courses; Driver education/Universities; Driver education/Public relations; Driver education/Handicapped

drivers; Driver education/Great Britain; Driver education/Western Australia; Motorcycle safety

HS-009 056 Fld. 3/5**THE THEORY AND PRACTICE OF PROGRAMMED INSTRUCTION AS RELATED TO DRIVER AND TRAFFIC SAFETY EDUCATION**

by Frazier Damron

Published in *Contemporary Education* v41 n4 p166-71 (Feb 1970)

17 refs

The advantages of the programmed instruction technique in driver education are discussed. Three distinct approaches are used in programmed instruction, each following a different philosophy of how learning can best be achieved. These approaches are the linear programming technique, which permits no errors; the scrambled text type, which uses multiple choice selections; and the branching technique, which also uses multiple choice selections but returns the student to simpler material if he makes errors.

Search terms: Programmed instruction/Driver education; Programmed instruction/Highway safety; Learning rates/Programmed instruction; Linear programming/Driver education

HS-009 057 Fld. 3/5**HAVE A PIECE OF HUMBLE PIE**

Anonymous

Published in *Air Force Driver* v3 n9 p8-13 (Feb 1970)

A collision avoidance driving course for Air Force officers is described. Drivers try to react quickly and accurately to traffic light changes on a driving range without knocking over pylons.

Search terms: Driver education/Automobile driving ranges; Traffic lights/Driver reaction time; Defensive driving; Automobile driving ranges/Cones

HS-009 058 Fld. 3/5**SPACE AGE DRIVER EDUCATION**

by Walter W. Gray

Published in *Contemporary Education* v41 n4 p162-5 (Feb 1970)

A demonstration center for driver safety education at Indiana State University is described. The facility includes classrooms, multiple car driving range, simulators, communications equipment, and electronic teaching devices. A five-phase program for training driver education teachers is described.

Search terms: Driver education/Instructors; Driver education/Classroom driver instruction; Driver education/Multiple car driving instruction; Driver education/Automobile driving ranges; Driver education/Driving simulators; Electronic devices/Driver education; Television/Driver education

HS-009 059 Fld. 3/5; 3/6**AMERICAN DRIVER EDUCATION: BILLION \$\$ FIASCO**

by Norman R. Beebe

Published in *California Highway Patrolman* v33 n6 p11, 53-9 (Aug 1969)

It is suggested that high school driving courses are so inferior that they produce poor risk drivers and that great improvement is needed in driver education. Commercial driving schools are also discussed and rated as excellent to poor in quality. Higher standards for driver licensing are urged as a solution to the problem of unfit drivers.

Search terms: Driver education/High risk drivers; Commercial driving schools; High school driving courses; Driver license standards; Driver education evaluation

JUNE 4, 1971

3/6 Driver Licensing

HS-009 060 Fld. 3/6

DRIVER LICENSE ADMINISTRATION REQUIREMENTS AND FEES

Bureau of Public Roads, Washington, D. C. B33600

1970 9p

Qualifications required to obtain driver licenses in the 50 states and the District of Columbia are given. A series of tables shows the administration, terms, age requirements, restrictions on minors, examination and renewal requirements, reciprocity among states, items included on the operator's license, and fees and service charges. Information is also given on states which classify driver licenses according to the type of vehicle.

Search terms: Driver license laws /State laws; Driver license examination; Driver license renewal; Driver licenses; Classified driver licenses; Driver licensing /Age factors; Driver license restrictions; Driver license standards; Interstate compacts /Driver licensing; License fees /Driver licensing

HS-009 061 Fld. 3/6

THE H. G. V. DRIVER'S LICENSE: PASSPORT FOR PROFESSIONAL

by A. J. P. Wilding

Published in *Commercial Motor* v130 n3333 p40-4 (1 Aug 1969)

A special driver's license for drivers of heavy goods vehicles will become a legal requirement in Great Britain. Requirements for the license include a physical examination, a good driving record, and passing of a skill test which will include reversing, steering, and braking.

Search terms: Truck drivers /Classi-

fied driver licenses; Driver license standards /Truck drivers; Driver records /Truck drivers; Driver physical examinations /Truck drivers; Driver tests /Steering; Driver tests /Braking; Driver tests /Backing; Driver license standards /Great Britain; Driver license laws /Great Britain; Driver skills /Truck drivers

HS-009 062 Fld. 3/6

DRIVER LICENSING EXEMPTIONS

by Gary M. Heller

National Committee on Uniform Traffic Laws and Ordinances, Washington, D. C., N14400

Published in *Traffic Laws Commentary* n70-1 p1-22 (6 Feb 1970)

149 refs

This commentary reviews state laws granting exemptions from the requirement to have a driver's license and compares them with section 6-102 of the Uniform Vehicle Code. Provisions are discussed regarding government employees, licensed nonresidents, unlicensed nonresidents, nonresident military personnel, military personnel returning from overseas, drivers of farm and other vehicles, and miscellaneous exemptions.

Search terms: Driver license laws /State laws; Driver license laws /Uniform Vehicle Code; Driver license laws /Law waivers; Driver license laws /Government employees; Driver license laws /Military drivers; Driver license laws /Farm vehicles; Driver license laws /Out of state drivers; Driver license laws /Unlicensed drivers

3/12 Vision

HS-009 063 Fld. 3/12; 2/7; 3/8

AFTER THE SUN GOES DOWN

Anonymous

OTHER SAFETY-RELATED AREAS

Published in *Air Force Driver* v3 n8 p16-9, 26 (Feb 1970)

Good vision is emphasized as a factor in safe driving at night. Drugs and smoking also are mentioned as a hazard to safe night driving.

Search terms: Vision /Night driving; Night vision /Highway safety; Drugs /Night driving; Alcoholic beverages /Night driving; Smoking /Night driving

4/0 OTHER SAFETY-RELATED AREAS

4/1 Codes and Laws

HS-009 064 Fld. 4/1

HIGHWAY TRANSPORTATION LEGISLATION IN 1969

Highway Users Federation for Safety and Mobility, Washington, D. C., H13400

[1970] 38p

This summary of federal and state legislation covers environmental matters; highway taxation and finance; mass transit; highways; uniform laws and motor vehicle regulation; highway safety laws; driver licensing and control; financial responsibility; traffic control devices; speed limits; equipment requirements; periodic vehicle inspection; size and weight limits.

Search terms: Federal laws; State laws; Environmental planning /Laws; Highway taxation /Laws; Public transportation /Laws; Law uniformity; Inspection laws; Vehicle inspection; Vehicle laws; Safety laws; Driver license laws; Financial responsibility /Laws; Traffic control devices /Laws; Speed limits; Vehicle size limits; Vehicle weight limits

AVAILABILITY: Corporate author \$5.00

HS-009 065 Fld. 4/1; 5/19

PROHIBITING THE LEAVING OF IGNITION KEYS IN UNATTENDED MOTOR VEHICLES

4/1 Codes and Laws (Cont'd.) HS-009 065 (Cont'd.)

Oregon Univ., Eugene, 018450

Mar 1969 7p

Report no. Legal-Bull-12

Prepared in corporation with the League of Oregon Cities.

The evidence is clear that leaving ignition keys in unattended automobiles contributes to car theft. Cities have authority under the police power to prohibit this practice. A model ordinance regulating unattended motor vehicles is given.

Search terms: Theft prevention/Laws; Ignition keys/Theft; Ignition keys/Stolen vehicles; Theft prevention/Ignition locks

HS-009 066 Fld. 4/1; 5/19

REMOVAL OF IGNITION KEYS

by John W. English

National Committee on Uniform Traffic Laws and Ordinances, Washington, D. C., N14400

Published in *Traffic Laws Commentary* n70-2 p1-20 (20 Feb 1970)

143 refs

The Uniform Vehicle Code specifies that drivers leaving their vehicles unattended must "lock the ignition and remove the key." This commentary reviews the obligations imposed by this phrase and includes a review of state statutes and pertinent court decisions.

Search terms: Ignition locks/Uniform Vehicle Code; Ignition locks/Court decisions; Ignition keys/Stolen vehicles; Ignition locks/State laws; Stolen vehicles/Liability; Stolen vehicles/Negligence

4/3 Cost Effectiveness

HS-009 067 Fld. 4/3; 5/21

COST OF OPERATING AN

AUTOMOBILE. CENTS PER MILE

Bureau of Public Roads, Washington, D. C., B33600

Feb 1970 11p

Cost per mile and total costs for operating an automobile are given by age of vehicle and for ten year period. Estimates of operating costs are based on initial price; accessories; maintenance and repair; replacement tires; gasoline and oil; insurance; garaging, parking, tolls; taxes; finance charges and interest.

Search terms: Automobile costs/Mileage; Vehicle age/Automobile costs; Automobile costs/Depreciation; Automobile costs/Pricing; Automobile costs/Maintenance; Automobiles/Repair costs; Automobile costs/Tires; Automobiles/Fuel costs; Automobile costs/Lubrication; Automobiles/Insurance costs; Automobile costs/Taxation; Automobile costs/Garages; Automobiles/Parking costs; Automobile costs/Tolls; Automobile costs/Financing

4/4 Governmental Aspects

HS-009 068 Fld. 4/4; 1/3

THE ROLE OF THE FEDERAL GOVERNMENT IN TRAFFIC ACCIDENT PREVENTION

by David Wolochow

Canada. Government Specification Board, Ottawa, Ont., C25800

Published in *Proceedings of the 1967 Convention, Canadian Good Roads Association*, 1970, p534-56

Presented at convention of the Canadian Good Roads Association, Vancouver, B. C., 25-28 Sep 1967.

What the government has done in the field of traffic safety is reported. Included are the following appendices:

The Canadian Government Specifications Board functions; excerpt from an address by the Postmaster General to the Canadian Highway Safety Council; membership list of the CGSB Committee on Traffic Safety; list of the automotive vehicle safety standards issued by the Canadian Government Specifications Board; statement regarding activities of the Motor Vehicle Accident Study Group of the National Research Council; statement to the House of Commons Standing Committee on Justice and Legal Affairs on Automotive Safety; and excerpts from United States legislation on motor vehicle safety.

Search terms: Accident prevention/Federal role; Accident prevention/Canada; Accident prevention/United States; Accident prevention/Federal state relationships; Highway safety/Federal role; Vehicle safety standards; Safety laws

4/8 Transportation Systems

HS-009 069 Fld. 4/8

THE HIGHWAY USERS FEDERATION FOR SAFETY AND MOBILITY AND THE HIGHWAY TRANSPORTATION STRUCTURE

by Cullison Cady

Published in *Highway User* p12-5 (Feb 1970)

Contributions to highway transportation that the Highway Users Federation is geared to make are discussed.

Search terms: Highway transportation/Highway Users Federation for Safety and Mobility; Transportation planning

HS-009 070 Fld. 4/8

CARS AND CITIES ON A COLLISION COURSE

by Allan T. Demaree

JUNE 4, 1971

VEHICLE SAFETY

Published in *Fortune* v81 n2 p124-128, 187-188 (Feb 1970)

The automobile made America mobile but is now making it less livable. The search for alternatives such as improved bus systems is discussed. Aspects of the urban traffic problem include a great increase in the number of cars, pressure for more highways and parking facilities, congestion, and air pollution. Various ideas in transportation planning for the future are outlined.

Search terms: Transportation planning /Urban transportation; Traffic congestion /Urban transportation; Vehicle air pollution /Urban areas; Buses /Urban transportation; Traffic management /Urban areas; Highway planning /Urban areas; Parking /Urban areas

5/0 VEHICLE SAFETY

5/1 Brake Systems

HS-009 071 Fld. 5/1

EXHAUST BRAKES AND RETARDERS. A REVIEW OF THE TYPES OF UNITS AVAILABLE AND THEIR PERFORMANCE

Anonymous

Published in *Automobile Engineer* v60 n3 p103-7 (Mar 1970)

Considerations of safety and the possible use of vehicles with gross weights of over 40 tons have aroused renewed interest in the installation of exhaust brakes or retarders on heavy trucks. Various units are described. Any of them can improve the safety of large trucks, but in many cases the amount of improvement depends on the use made by the driver of the retarder. The more powerful units are heavy and costly. For any real improvements, automatic controls and integral units installed by the vehicle manufacturer are needed.

Search terms: Exhaust brakes /Truck brakes; Truck brakes /Retarders; Ex-

haust brakes /Retarders; Vehicle weight /Trucks; Exhaust brakes /Performance characteristics; Retarders /Performance characteristics

HS-009 072 Fld. 5/1; 5/18

ROAD-HOLDING: BRAKING AND TRACTION. STATE-OF-THE-ART

by Jean Odier

Societe Anonyme Francaise du Ferodo, Paris (France), S20600

Published in *1970 International Automobile Safety Conference Compendium (P-30)*, New York, 1970, p204-9

39 refs

Report no. SAE-700367

Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

Instability phenomena are divided into two groups: defects of braking stability without wheel locking, such as stresses, pulls, and deviation; and defects in braking stability with locked wheels. Improvements in European braking systems to eliminate these problems are discussed.

Search terms: Wheel locking; Brake systems /European vehicles; Vehicle stability /Brake systems; Brake failures; Traction /Vehicle stability

AVAILABILITY: SAE; also in HS-007 859

5/4 Design

HS-009 073 Fld. 5/4

G.K.N.-S.R.M. AUTOMATIC TRANSMISSION FOR TRUCKS, BUSES AND OFF-HIGHWAY VEHICLES

by R. L. Abbott

Guest, Keen, and Nettlefolds Birfield Transmissions Ltd., Sheffield, Yorks, (England), G290000

1971 10p

Report no. SAE-710202

Presented at Automobile Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

Sound economic and mechanical reasons justify the use of automatic transmissions of high efficiency. The G.K.N.-S.R.M. transmission links an epicyclic gear train with an unconventional converter blade system to change conditions of fluid flow and give a very high stall torque ratio. Hydraulic efficiencies in the converter stages are discussed and torque distribution in the system is analyzed. Use is made of existing elements to give hydraulic braking at negligible additional cost. Simple modifications to the blade system allow accurate matching of the transmission to the engine while auxiliary gearing may be provided to give a wider ratio spread if required. The transmission control system is described. Another version of the converter with variable pitch impeller blades has been designed for use with turbine engines up to 400hp which may, with advantage, be of single-shaft type.

Search terms: Automatic transmissions /Trucks; Automatic transmissions /Buses; Automatic transmissions /Off the road vehicles; Automatic transmissions /Benefit cost analysis; Automatic transmissions /Diesel engines; Automatic transmissions /Turbine engines; Automatic transmission design; Automatic transmissions /Hydraulic torque converters

AVAILABILITY: SAE

HS-009 074 Fld. 5/4

DRIVELINES FOR HIGH PERFORMANCE

by Charles W. Haines

Dana Corp., Toledo, Ohio, D030000

5/4 Design (Cont'd.)

HS-009 074 (Cont'd.)

1970 9p
Report no. SAE-700742

Presented at Combined National Farm, Construction and Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., 14-17 Sep 1970.

Considerable data have been published on application factors and theory of Cardan type universal joints. Significant improvement in product performance can also be obtained through design innovations of component parts. This paper shows how several development programs involving design and material have generated higher performance from universal joints. Product development directed toward meeting industry requirements over the next ten years and new areas of application are also examined.

Search terms: Drivelines /Performance characteristics; Universal joints /Performance characteristics; Universal joints /Laboratory tests; Universal joints /Field tests; Universal joint design

AVAILABILITY: SAE

HS-009 075 Fld. 5/4

RELATIONSHIP BETWEEN OIL FILM THICKNESS AND WEAR OF JOURNAL BEARINGS

by Andreas Gerve; Gustav Katzenmeier; Karl Kollmann

Karlsruhe Univ. (West Germany), K03100

1971 7p 11 refs
Report no. SAE-700717

Presented at Combined National Farm, Construction and Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., 14-17 Sep 1970.

Lubrication of moving parts becomes less efficient in those areas where close fit limits the amount of lubricant to a very thin oil film. Journal bearings are particularly vulnerable in this respect. To test the degree of wear, a radioisotope technique was applied in which shafts and bearings were deuterium activated. Not only did the tests prove sufficiently sensitive to determine the full range of hydrodynamic lubrication, but they also identified the transition point at which poor lubrication caused journal-bearing wear. It was also found that materials of the shaft and bearings greatly influenced the amount of wear.

Search terms: Journal bearing wear /Lubrication; Wear tests /Radioisotopes; Journal bearings /Wear tests; Shaft materials; Bearing materials; Journal bearing wear /Laboratory tests; Journal bearing wear /Surface roughness

AVAILABILITY: SEA

HS-009 076 Fld. 5/4

A METHOD OF CALCULATING THE HEAT DISSIPATION FROM RADIATORS TO COOL VEHICLE ENGINES

by R. A. Beard; G. J. Smith

Associated Engineering Developments Ltd., North Rugby, Warwick (England), A70250

1971 9p 5 refs
Report No. SAE-710208

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

Several basic heat transfer equations have been utilized to enable the calculation of the thermal performances of vehicle radiator cores. The application of the calculation procedure to the two types of radiator matrix in general use has been shown in some detail, and results using these methods have been compared with experimental values.

These correlations have shown that the calculation procedure can be used with confidence to predict matrix dissipations for Reynolds numbers in the water tubes of less than 1000, as found in automobile heater cores, as well as for the larger Reynolds numbers in the water tubes typical of automobile radiator cores.

Search terms: Radiators /Heat transfer; Heat transfer /Equations; Radiators /Performance characteristics; Radiators /Thermodynamics; Wind tunnel tests /Radiators; Radiator design

AVAILABILITY: SAE

HS-009 077 Fld. 5/4

FATIGUE STRENGTH AS A DESIGN CRITERION

by J. G. Hicks

Welding Inst., London (England), W12800

1970 11p 8 refs
Report no. SAE-700556

Presented at Earthmoving Industry Conference, Central Illinois Section, Peoria, Ill., 14-15 Apr 1970

The major factor determining the fatigue life of a welded structure under a given loading is the configuration of the weldments. The selection of various steel types and welding processes are considered to be secondary influences on the fatigue strength. It is possible to improve the fatigue strength of weldments by a number of practical techniques. Research in progress indicates that the fatigue behavior of weldments can be predicted by the application of fracture mechanics theory; it is hoped that this will lead to a clearer understanding of fatigue and the development of more refined techniques of fatigue life calculation. The author offers a checklist of suggestions to structural designers.

Search terms: Welds /Structural design; Welds /Fatigue life;

Welds /Loading (mechanical); Vehicle design /Welds; Welding /Fatigue (materials); Steels /Welding

AVAILABILITY: SAE

HS-009 078 Fld. 5/4

A NEW TYPE OF BEARING FOR PASSENGER CAR FLANGED AXLES

by R. L. Williams; R. E. McKelvey

Timken Roller Bearing Co., Canton, Ohio, T23800

1970 8p

Report no. SAE-700127

Presented at Automotive Engineering Congress, Detroit, Mich., 12-16 Jan 1970.

A brief description of present day rear axle designs and their bearings is given. A complete discussion is included of the design objectives of a new concept in single row tapered roller bearings and of the design features of this new bearing. The new bearing is preadjusted and carries thrust loads in either direction, as well as radial loads in any combination. A detailed discussion of its development and testing, both laboratory and field, is presented.

Search terms: Rear axles /Bearings; Bearing tests /Field tests; Bearing tests /Laboratory tests; Loading (mechanical) /Bearings; Bearings /Performance characteristics

AVAILABILITY: SAE

HS-009 079 Fld. 5/4

AN AUTOMATIC HEATER SYSTEM — DESCRIPTION AND PERFORMANCE PREDICTION

by A. G. Plackett

Institution of Mechanical Engineers, London (England), I35400

Published in *Proceedings of The Institution of Mechanical Engineers*. 1968-69, v183 pt2A, n7 p125-36

The objective of the system is to control the car heater temperature to ensure an optimum comfort level, without the need for periodic adjustment, despite variations in ambient temperature and vehicle usage. Reasons for choosing a particular type of system are explained. The operation is analysed, and expressed in terms of an equation. Difficulties in solution due to non-linear terms are overcome with the aid of a digital computer. Test data on the system components and vehicle characteristics are used in the computer program to obtain a prediction of the accuracy of temperature control over a wide range of operating conditions. Predicted performance is compared with actual road tests results for an installation. Design optimization is facilitated by using the computer to examine the effect of system parameter changes on the overall performance.

Search terms: Heaters /Performance characteristics; Performance characteristics /Forecasting; Heaters /Automatic control; Heaters /Equations; Heaters /Digital computers

HS-009 080 Fld. 5/4

THE NEW YORK SAFETY CAR. ITS EVOLUTION AND ITS PROGRESS

by B. Y. Scott

New York (State). Dept of Motor Vehicles, Albany, N50400

Published in *Conference on Road Safety*. Vol. 2, Brussels, 1968, A14-1 to A14-34

Abstracts in English, French, Dutch, and German

New York State has proceeded from the original concept of a safety car, in 1960, to the creation of the Safety Sedan — a practical, life-saving, vehicle that can prevent accidents and injuries, and can be mass produced. The program includes

all classes of vehicle safety: accident prevention; crash injury prevention; pedestrian injury prevention; rescue and postcrash safety; and nonoperating systems. The safety level is defined by an overall safety rating and by simplified ratings of individual types of safety performance.

Search terms: Safety cars /History; Safety cars /Accident prevention; Safety cars /Injury prevention; Safety cars /Postcrash phase; Safety cars /Performance characteristics; Front engine vehicles /Safety cars; Four wheel drive vehicles /Safety cars; Four wheel brakes /Safety cars; Bucket seats /Safety cars; Restraint systems /Safety cars; Eye location /Safety cars; Field of view /Safety cars; Rear visibility /Safety cars; Periscopes /Safety cars; Vehicle lighting /Safety cars; Body design /Safety cars; Pedestrian accidents /Safety cars; Bumper design /Safety cars; Parked vehicles /Safety cars; Safety cars /Indexes

HS-009 081 Fld. 5/4

NSU'S DOUBLE BANK ROTARY ENGINE FEATURES DUAL IGNITION SYSTEM, IMPROVED CAST-IRON APEX SEALS

by Walter G. Froede

Published in *SAE Journal* v77 n4 p30-2 (Apr 1969)

NSU's new 120-cu in., 130-hp, double bank rotary engine, designated KKM 612, retains the trochoid geometry of the earlier well-known Spider engine. A dual ignition system provides superior combustion and eliminates the need for a costly condenser discharge ignition system. Cast-iron apex seals of a new design replace the carbon seals, which broke up under knocking conditions. The KKM 612 engine powers the NSU RO-80, a four-seat sedan. The RO-80 has front-wheel drive with the center of gravity of the drive unit (engine, torque converter, clutch, differential, and gearbox) ahead of the front axle.

5/4 Design (Cont'd.)

HS-009 081 (Cont'd.)

Search terms: Rotary engines; Dual ignition; Rotary engines /Engine size; Rotary engines /Apex seals; Rotary engines /Chassis design; Rotary engines /Performance characteristics; Apex seals /Cast iron

HS-009 082 Fld. 5/4

REFLECTORIZED REGISTRATION PLATES AND ALTERNATIVE MEANS. FUNCTION, DESIGN AND APPLICATION. VEHICLE PERCEPTIBILITY

Stichting Wetenschappelijk Onderzoek Verkeersveiligheid, Voorburg (Netherlands), S45000

1970 62p 25 refs
Report no. NN-44-88

The design of reflectORIZED registration plates has been examined from the aspect of perceptibility. Recommendations are given regarding reflection, diffuse reflection, color, dimensions of plates, and types of letters and figures. The use of character type D, designed by the U. S. Bureau of Public Roads, is recommended for the Netherlands to increase legibility distance by 35%.

Search terms: ReflectORIZED license plates /Vehicle visibility; ReflectORIZED license plates /Color; ReflectORIZED license plates /Type faces; ReflectORIZED license plates /Legibility

HS-009 083 Fld. 5/4; 5/1

A GUIDE TO UNDERLOAD VEHICLE TESTING. THE MODERN, DYNAMIC APPROACH TO AUTOMOTIVE TECHNOLOGY

Clayton Mfg. Co., El Monte, Calif., C46800

1950; 1969 128p

This textbook was prepared originally in 1950 for use in the company's chassis dynamometer training schools. These schools were highly successful in developing operators for hundreds of Clayton dynamometers. Many vocational and public schools engaged in teaching automotive technology have adopted this textbook as a basic tool in their engine courses. The current edition incorporates the latest technology relative to the use of dynamometers in service shops. Because many students will be called upon to operate combination chassis dynamometers and dynamic brake analyzers, a section is devoted to the operation of the latter type of equipment. The emergence of the diagnostic center concept had underscored the importance of dynamic testing for engines, transmission, drive-lines, axles, and brakes.

Search terms: Dynamometers /Manuals; Dynamometers /Instruction materials; Diagnostic centers /Dynamometers; Dynamometers /Education; Chassis /Dynamic tests, Automotive engineering /Dynamic tests; Vehicles /Loading tests; Service centers /Dynamometers; Brake tests /Dynamometers; Engine tests /Dynamometers; Transmission tests /Dynamometers; Drive-lines /Dynamic tests; Axles /Dynamic tests; Horsepower /Dynamic tests; Compression tests /Dynamometers; Carburetors /Dynamic testing; Ignition tests /Dynamometers

AVAILABILITY: Corporate Author \$3.95

5/6 Fuel Systems

HS-009 084 Fld. 5/6

NATIONWIDE INVENTORY OF AIR POLLUTANT EMISSIONS 1968

National Air Pollution Control Administration, Raleigh, N. C., N05700

Aug 1970 45p 13 refs
Report no. AP-73

Estimates of the 1968 nationwide emissions of the five primary air pollutants: carbon monoxide, sulfur oxides, particulates, hydrocarbons, and nitrogen oxides are summarized. Emission trends from 1966 through 1968 are included as well as motor vehicle emissions projected to 1990. Methodology and basic data used to make the emission estimates such as fuel usage, vehicle miles of travel, and solid waste disposal methods are also presented. Accuracy of estimates for given pollutants varies. Estimates for carbon monoxide, sulfur oxides, and nitrogen oxides should be accurate but lack of emission factors and basic source information may cause the others to be inaccurate. Projections, based on regulations now in force and forthcoming in 1970 and 1971, are for gasoline-powered vehicles only, and are given for carbon monoxide, hydrocarbons, and nitrogen oxides. The first two are expected to decrease steadily until about 1980 when increased vehicle travel will offset controls. Because of lack of controls, the last will increase steadily at the travel rate.

Search terms: Air pollution /Emissions; Air pollution emission tables /Sulfur oxides; Air pollution emission tables /Hydrocarbons; Air pollution emission tables /Nitrogen oxides; Industrial air pollution; Power plant air pollution; Air pollution emission tables /Carbon monoxide; Emissions /Forecasting; Emissions /Fuel consumption; Emissions /Vehicle mileage; Emissions /Solid waste disposal; Air pollution /Surveys; Emissions /Data; Air pollution emission tables /Particulate air pollutants

AVAILABILITY: GPO \$0.30

HS-009 085 Fld. 5/6

CHEMICAL IDENTIFICATION OF THE ODOR COMPONENTS IN DIESEL ENGINE EXHAUST. FINAL REPORT

JUNE 4, 1971

VEHICLE SAFETY

Little (Arthur D.), Inc., Cambridge, Mass.

Jul 1969 102p
Contract PH-22-68-20; CD-13-64
Report no. C-70131; C-70132; PB-185 878

The objectives of this program were to determine the relative contribution of individual chemical species in diesel exhaust to the intensity and character of the exhaust odor and to describe these species in terms of chemical parameters. The steps involved were: characterization of the odor components, using olfactory techniques; separation of odor components from the exhaust; chemical identification of odor components; and determination of operating conditions on the presence of specific odor components. Emphasis was on the first two steps. Recommendations for further research are made.

Search terms: Diesel engine exhaust emissions /Odors; Odorants /Chemical properties; Odorants /Identification; Engine operating conditions /Diesel engine exhaust emissions

HS-009 086 Fld. 5/6

FORD MOTOR COMPANY'S MOBILE EMISSIONS TEST LABORATORY

by C. W. Schwartz

Ford Motor Co., Dearborn, Mich., F18600

1971 9p
Report no. SAE-710170

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

Design features and construction details of Ford Motor Company's recently commissioned Mobile Emissions Test Laboratory are described. The lab contains all facilities — chassis dynamometer, gas analyzer, test environment, and support services — necessary for the conduct of federal emissions tests

anywhere in the country. The laboratory is contained within a large semitrailer, compartmented into three sections for instrumentation, vehicle test, and support equipment. The center vehicle test section is expanded on site, providing an enclosed 13 x 30 foot area with built-in chassis dynamometer. A convenient feature is the "drive through" for test cars. The Mobile Emissions Test Laboratory can operate at temperatures as low as -10F and has provided accurate, reliable results on field tests.

Search terms: Mobile emission test laboratories /Ford Motor Co.; Dynamometers; Gas analyzers; Emission tests /Federal control; Test facilities /Safety design; Test facilities /Temperature

HS-009 087 Fld. 5/6

WHAT'S THE FUTURE FOR AUTOMOTIVE EMISSION CONTROL?

by Fred W. Bowditch

General Motors Research Labs., Warren, Mich., G10800

1971 19p

Presented to Joint American Gas Association-Edison Electric Institute Distribution Conference, Chicago, Ill., 10-13 May 1971.

It is suggested that the public thinks the auto is the cause of most air pollution and that the automotive industry is doing nothing about the problem, and that these are misconceptions. The percentages of various air pollutants for which the auto is responsible are discussed. The efforts being made by the auto industry, particularly General Motors, to control emissions are described.

Search terms: Air pollution emission factors; Air pollution control; Air pollutants /Internal combustion engines; Emission control /Internal combustion engines; Automotive industry /Emission control

HS-009 088 Fld. 5/6

PROGRESS AND PROGRAMS IN AUTOMOTIVE EMISSIONS CONTROL. A PROGRESS REPORT BY GENERAL MOTORS CORPORATION TO U. S. ENVIRONMENTAL PROTECTION AGENCY

General Motors Corp., Detroit, Mich., G06600

12 Mar 1971 115p

The present state of auto emission control is described, the programs now underway to effect further improvements are discussed, and the problems and challenges in attempting to meet new federal standards are outlined. Aspects discussed include studies of other power sources; how pollutants are formed; improved systems for 1975 models; possible fuel changes; test procedures; 1975-76 numerical standards for emissions; warranty and recall provisions.

Search terms: Air pollution control; Air pollution emission factors; Emission standards; Emission control; Air pollutants; Fuels; Emission tests; Warranties; Recall campaigns; Automobile power

5/7 Glazing Materials

HS-009 089 Fld. 5/7

SAFETY GLASS IN MOTOR VEHICLES

Anonymous

Published in *Automotive Design Engineering* v8 p60-1 (Sep 1969)

6 refs

Broken glass is still considered by some authorities to be the third most common source of injury to passengers in vehicles, and new forms of glazing are being sought. Some of the advances made since 1962 are summarized. Glass attachment,

VEHICLE SAFETY

HSL No. 71-17

5/7 Glazing Materials (Cont'd.) HS-009 089 (Cont'd.)

breaking stress, properties of chemically strengthened glass, and laminated glass are briefly discussed.

Search terms: Safety glass; Laminated glass; Chemically strengthened glass /Properties; Breaking /Safety glass; Stresses (mechanics) /Safety glass; Glass caused injuries /Injury prevention

5/9 Inspection

HS-009 090 Fld. 5/9

PERIODIC INSPECTION OF MOTOR VEHICLES IN SWEDEN. ORGANIZATION AND STATISTICS

by Alexej Pellijeff

Svensk Bilprovning, A. B., Stockholm (Sweden), S53400

Published in *Conference on Road Safety*. Vol. 3, Brussels, 1968, pB3-1 through B3-11.

Summaries in French, Swedish, and German.

Since Jan. 1, 1965, all road vehicles in Sweden which are three years old or older have been inspected annually. Results can be regarded as comprehensive reliability and durability test results for the various vehicles and components. Statistical surveys of the inspection results have proved valuable to manufacturers, garages, and vehicle owners.

Search terms: Vehicle inspection /Sweden; Vehicle inspection /Statistical analysis; Vehicle inspection /Vehicle age

HS-009 091 Fld. 5/9

AN EVALUATION OF THE NEW JERSEY MOTOR VEHICLE IN-

SPECTION SYSTEM. FINAL REPORT

by Howard Eisner; S. R. Kalin; E. N. Wells; D. P. Manahan

Operations Research, Inc., Silver Spring, Md., O15000

30 Jun 1970 171p refs
Contract P-169

A six-month evaluation of the New Jersey motor vehicle inspection system found that it had no serious fault in organization, but that station supervisors' time was misallocated, examiners' training was inadequate, the salary structure was inequitable, the existing data system was inadequate, and there were disadvantages in having registration precede inspection. Recommendations for improvement of the system are made.

Search terms: Vehicle inspection /New Jersey; Inspection effectiveness /Evaluation; Inspection procedures /Evaluation; Inspector training /Evaluation; Vehicle inspection /Statistical analysis; Vehicle registration /Vehicle inspection

HS-009 092 Fld. 5/9; 4/1 INSPECTION LAWS

ANNOTATED. ANNUAL SUPPLEMENT. 1970

National Committee on Uniform Traffic Laws and Ordinances, Washington, D. C., N14400

c1971 56p
Contract FH-11-6869

The main volume presented detailed information about state vehicle inspection legislation adopted prior to January 1, 1969. This supplement updates Part 3 of the main volume by indicating how the annotations have been changed as a result of legislative activity taking place since 1969; and updates Part 4 of the main volume by reprinting state laws that were affected by action of the legislatures in 1969.

Search terms: Inspection laws /State action; Inspection /State laws; Inspection stations /State laws

5/10 Lighting Systems

HS-009 093 Fld. 5/10

MOTOR VEHICLE LIGHTING AND SELF LEVELING DEVICES FOR HEADLAMPS

by Pierre Cibie

Projecteurs Cibie, Bobigny (France), P35700

Published in *1970 International Automobile Safety Conference Compendium* (P-30), New York, 1970, p599-607

Report no. SAE-700389

Text also in French. Includes summary in German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

The general automobile lighting principles and American and European designs are summarized. It is suggested that a self levelling device is desirable and in some instances even required. Self levelling design principles are established and details given on a hydraulic leveller and on compensation of thermic variations.

Search terms: Headlamps /Design standards; Low beamed headlamps /Design standards; Hydraulic equipment /Headlamps; Temperature /Headlamps; Headlamps /European vehicles; Headlamps /Brightness

AVAILABILITY: SAE; also in HS-007 859

5/14 Occupant Protection

HS-009 094 Fld. 5/14

OPTIMUM UTILIZATION OF THE VEHICLE AVAILABLE OCCUPANT SPACE TO ENSURE PASSENGER PROTECTION

by C. Tarriere; R. Rebiffe; J. Hamon; G. Mauron

Automobiles Peugeot, Paris (France), A80700

Published in *1970 International Automobile Safety Conference Compendium* (P-30), New York, 1970, p82-111

31 refs

Report no. SAE-700360

Includes summaries in French and German. Presented at 1970 International Automobile Safety Conference: Detroit, Mich., 13-15 May 1970, Brussels, Belgium, 8-11 Jun 1970.

An improved utilization of the frontal survival space between front seat occupants and the occupant enclosure. The authors propose a belt design and a crash seat transversally pivoted at the base with rotational shock absorber. This would apportion the deceleration forces on the passenger better. Impact tests of this system with dummies are described. The levels of impact producing minor and serious injuries to different parts of the body are discussed.

Search terms: Safety seats/Deceleration; Occupant protection/Deceleration; Seat belts/Deceleration; Shoulder harnesses/Deceleration; Impact tolerances; Occupant protection/Secondary collisions; Impact tests/Dummies; Impact tests/Safety seats; Impact tests/Restraint systems; Injury research/Impact tests

AVAILABILITY: SAE; also in HS-007 859

HS-009 095 Fld. 5/14

BIOMECHANICS OF HEAD PROTECTION

by G. G. Snively; S. A. Snively

Snell Memorial Foundation, Inc., N. Tarrytown, N. Y., S19600

Published in *Conference on Road Safety. Vol. 1*, Brussels, 1968, pA6-1 to A6-4

5 refs

Abstracts in English French, Dutch, and German.

Requirements of usage which must be considered in the design of helmets are presented, and some explanations given of the biomechanical principles involved in meeting these needs. The relationships of various protective materials and systems to basic principles of energy transfer are discussed, and some considerations are given to animal experiments in the study of the mechanisms of head injury. A brief analysis is presented of field data from approximately 300 accidents involving road user helmets. Correlation of injury to site and number of impacts, vehicle velocity, and impact energy absorbed is made.

Search terms: Head protection/Biomechanics; Helmet design; Headgear/Noise control; Head protection/Dynamic tests; Helmets/Impact tests; Linear regression analysis/Head impact tolerances; Laboratory animals/Head injuries; Injuries/Impact velocity

HS-009 096 Fld. 5/14

THE SIGNIFICANCE OF SLACK IN RESTRAINT OF VARIOUS STIFFNESS

by Bertil Aldman; Arne Asberg

Sweden. Statens Trafiksakerhetsrad, Stockholm, S58200

Published in *Conference on Road Safety. Vol. 1*, Brussels, 1968, pA5-1 through A5-19.

18 refs

Summaries in French, Dutch, and German.

The response of a restrained car occupant to deceleration patterns recorded at barrier impacts with some European cars is studied, using a simple model in an analog computer. In order to illustrate the general influence of restraint characteristics and slack, the occupant is defined as one solid mass and restraints are characterized by linear load-elongation functions of different stiffness. Peak accelerations and total displacements of the occupant as a function of slack are given.

Search terms: Barrier collision tests/Restraint systems; Restraint systems/Deceleration tests; Barrier collision tests/European vehicles; Barrier collision tests/Computerized simulation; Loading tests/Restraint systems; Acceleration/Restraint systems; Displacement/Restraint systems; Restraint systems/Stiffness

HS-009 097 Fld. 5/14

SEAT BELT INSTALLATION AND USE

by C. Thomas VanVechten

District of Columbia. Bureau of Traffic Engineering and Operations, Washington, D18600

Sep 1967 19p

Report no. PB-183 589

Prepared in cooperation with U. S. Department of Transportation, Office of Highway Administration, Bureau of Public Roads. Published as a *Traffic Operations Research* paper.

An investigation has been made of the installation of seat belts in passenger cars registered in the District of Columbia during the period from April 1, 1964 through March 31, 1965. Taxicabs were not included in the study. A study also was made of the use of seat belts in

5/14 Occupant Protection (Cont'd.)

HS-009 097 (Cont'd.)

passenger cars, excluding taxicabs, involved in fatal and non fatal injury accidents in the Washington Metropolitan Area. The effect of seat belt use on the severity of these accidents was also investigated.

Search terms: Restraint systems / Laws; Restraint systems / District of Columbia; Seat belt installation; Seat belt usage / Injury severity; Seat belt installation / Foreign vehicles; Seat belts / Automobile models; Seat belts / Vehicle age

AVAILABILITY: CFSTI

5/15 Propulsion Systems

HS-009 098 Fld. 5/15

EVERY MAN HIS OWN RE- ACTOR

by Karl Ludvigsen

Published in *Motor Trend* v23 n1 p44-6, 48, 75-7 (Jan 1971)

The ultimate solution of automotive air pollution is near at hand with reactors under the hood of a piston-engine car. The design and performance characteristics of thermal reactors are described.

Search terms: Thermal reactors / Performance characteristics; Vehicle air pollution

HS-009 099 Fld. 5/15

FREON VAPOR... VW POWER OF THE FUTURE?

by Harry L. Miller

Published in *World Car Guide* n139 p38-41, 57 (Sep 1969)

A smog-free freon-vapor powered external combustion engine developed by

Wallace L. Minto is described. It is expected to be commercially feasible. A Volkswagen bus was used as a test vehicle.

Search terms: Freon engines / Vapor engines; Minto freon automobiles; External combustion engines; Volkswagens / Buses

5/18 Steering Control System

HS-009 100 Fld. 5/18

VEHICLE DYNAMICS

by Jan P. Norbve

Published in *Automobile Quarterly* v9 n1 p81-93 (Fall 1970)

The axle, suspension, weight transfer and roll, wheel loading and tires are discussed in relation to vehicle handling. The history of vehicle steering and handling and the key persons in such engineering are presented.

Search terms: Vehicle dynamics / History; Vehicle handling; Steering; Roll; Axles; Suspension systems; Tire loads / Cornering; Understeer; Oversteer

HS-009 101 Fld. 5/18

RANDOM LOAD FATIGUE TEST UPON AUTOMOTIVE COM- PONENTS AND STRUCTURES

by J. D. Camp

General Motors Corp., Pontiac, Mich., G08050

1969 22p 10 refs

Advance copy of a paper to be presented before a Symposium on Advanced Simulated Service Testing Techniques at the annual meeting of the American Society for Testing and Materials, Philadelphia, Pa., Jun 1969.

This paper discusses Pontiac's present approach to analysis of the input parameters influencing a test vehicle in a road test environment. The material is presented under the following headings: vehicle suspension dynamics; random vibration theory and instrumentation techniques; simulation of the road in the laboratory; and correlation of road test to the laboratory test environment.

Search terms: Random vibration analysis / Suspension systems; Load tests; Fatigue tests; Road simulation; Road tests

HS-009 102 Fld. 5/18

AN INVESTIGATION INTO THE DYNAMIC STABILITY OF STEERING SYSTEMS

by R. P. La Barre; B. Mills

Institution of Mechanical Engineers, London (England), I35400

Published in *Proceedings of the Institution of Mechanical Engineers*. 1968-69, v183 pt2A n7 p125-36

15 refs

The historical background of the automobile shimmy problem is outlined. The behaviour of a suspension and steering system is predicted using a one-term harmonic approximation to the solution of the simplified equations of motion of the system. These equations include the effects of the non-linear variation of the tyre aligning torque with applied slip angle and of the relaxation properties of the tyre. The unstable frequency regions of the steering system are predicted with and without coupling of the steering and vertical suspension motions. An estimate of the level of damping required to suppress the shimmy motion is made. An apparatus for the determination of the relevant tyre properties is described. The experimental results obtained for the behaviour of a laboratory suspension unit are compared with those predicted theoretically and the agreement is found to be reasonable.

Search terms: Steering systems / Stability; Shimmy /History; Suspension systems /Equations of motion; Wheel alignment; Tire slip motion; Tire properties; Damping; Suspension systems /Road tests

HS-009 103 Fld. 5/18

ROLL STIFFNESS COULD SPELL DANGER

by P. A. C. Brockington

Published in *Commercial Motor* v130 n3338 p57 (5 Sep 1969)

The rollover tendencies of semitrailers are discussed. Roll stiffness, roll resistance, load transfer are discussed, and ways of improving the stability of vehicles, especially semitrailers, are briefly described.

Search terms: Vehicle stability /Semitrailers; Load shifting /Vehicle stability; Truck overturn accidents /Semitrailers; Roll /Semitrailers

5/20 Trucks and Trailers

HS-009 104 Fld. 5/20; 4/1

MOVING THE MACHINES THAT MOVE THE EARTH

by M. J. Mackie

Parkhill Truck Co., Joplin, Mo., P01050

1970 6p
Report no. SAE-700562

Presented at Earthmoving Industry Conference, Central Illinois Section, Peoria, Ill., 14-15 Apr 1970.

Some of the problems faced by specialized carriers in the movement of heavy construction machinery are presented. These include: size and weight limits; time required to obtain permits to move extra large or heavy loads; and time required to strip a machine to acceptable size or weight. Manufacturers can over-

come many of the problems through initial design of the machines, and through a closer working relationship between the carriers and manufacturers.

Search terms: Construction vehicle design; Construction vehicles /Transportation problems; Vehicle weight limits /Federal laws; Vehicle size limits /Federal laws

AVAILABILITY: SAE

HS-009 105 Fld. 5/20; 5/14

PROTECTION OF DRIVERS OF LORRIES AND AGRICULTURAL TRACTORS IN CASE OF OVERTURNING OR IMPACT

by G. Ekberg

Sweden. National Road Safety Board, Stockholm, S55800

Published in *Conference on Road Safety*. Vol. 2, Brussels, 1968, pA13-1 to A13-15

Abstracts in English, French, Dutch, and German.

On the basis of impact and loading tests, regulations for minimum standards have been established in Sweden for farm tractor and lorry cabs.

Search terms: Occupant protection / Tractor cabs; Farm tractor accidents / Sweden; Farm tractor design /Accident prevention; Farm tractor design / Injury prevention; Tractor cabs / Safety standards; Tractor cabs /Laws; Farm tractors /Impact tests; Farm tractors /Rollover tests; Truck cabs / Impact tests; Truck cabs /Rollover tests; Truck accidents /Sweden; Occupant protection /Truck cabs; Truck cabs /Loading tests; Truck cabs /Rollover tests; Truck cabs /Safety standards; Truck cabs /Laws; Farm tractors /Loading tests

5/22 Wheel Systems

HS-009 106 Fld. 5/22

LABORATORY MEASUREMENTS OF AIR CAVITY TEMPERATURE IN A PASSENGER CAR TIRE

by B. G. Simson; J. Mandel

Published in *Journal of Research of National Bureau of Standards Sec. C* v73C n1-2 p21-4 (Jan-Jun 1969)

5 refs

The air cavity temperature of a passenger car tire, running on a test wheel, was measured for different combinations of load, speed, and pressure. An empirical function was developed to illustrate the way in which the air cavity temperature of tires can be related adequately to given values of speed, load, and inflation pressure within the range covered by this laboratory experiment.

Search terms: Tire temperature / Laboratory tests; Tire loads / Laboratory tests; Tire inflation pressure /Laboratory tests; Tire temperature /Speed; Tire temperature /Tire loads; Tire temperature /Tire inflation pressure; Tire temperature /Statistical analysis

HS-009 107 Fld. 5/22

ADVANCES IN WET TYRE TRACTION

by T. French

Dunlop Co. Ltd., Birmingham, Warwick (England), D33000

[196-] 16p

References missing.

Tread materials and testing techniques are discussed in relation to traction under wet conditions.

Search terms: Tire treads /Wet road

NHTSA DOCUMENTS

HSL No. 71-17

5/22 Wheel Systems (Cont'd.)

HS-009 107 (Cont'd.)

conditions; Tire tests; Tire test equipment; Tire treads /Hydroplaning; Tire design /Laws; Tire traction /Wet road conditions; Braking distances /Wet road conditions; Grooving /Hydrodynamics; Road surfaces /Tire traction; Tire road contact forces

Mathematical models; Tire forces / Mathematical models; Fatigue (materials) /Tires; Tire loads /Mathematical models; Tire treads; Fibers / Deformation; Tires /Deformation; Tire mechanics

HS-800 428 Fld. 1/1; 5/14

ESCAPE WORTHINESS OF VEHICLES AND OCCUPANT SURVIVAL. FINAL REPORT. PT. 1: RESEARCH PROGRAM

by C. M. Sliepcevich; W. D. Steen; J. L. Purswell; J. N. Ice; J. R. Welker

Oklahoma Univ., Norman, O11350

Dec 1970 490p 205 refs
Contract FH-11-7303
Report no. 1729-FR-1-1

Part 2 and Part 3 are bound together and announced as HS-800 429

This is a final report on the results of a multidisciplinary study of the factors involved in escape of occupants from crashed vehicle environments in which the vehicle is incapacitated on land, submerged in water or involved in fire. The report consists of three parts in two volumes. The FIRST PART summarizes the investigative efforts, results and conclusions. Analysis of the availability and accessibility of information, including the published literature, reports, accident records and other documents related to escape worthiness of vehicles and occupant survival revealed that the quality and reliability of these resources were inadequate to provide guidance for clarifying or resolving these problem areas. Attempts to apply the epidemiologic method to these resources led to several tentative hypotheses which remain to be tested for validity. A series of programmed escape tests generated baseline data on human performance in escape from passenger vehicles and buses on land and passenger vehicles in water. Vehicle characteristics and human behavior are reflected in escape times for various passenger-population loads. Additional testing involved bus side

window retention and glazing strength. Extensive flammability tests were conducted on over fifty materials used in the interior of vehicles. These experiments included the conventional horizontal burn rate, vertical burn rate, radiant panel or flame spread index, the FMVSS 302, and the OURI ignition test. Status of the art surveys were completed on fuel safety through fuel modifications and on fire extinguishment.

Search terms: Bibliographies /Research methods; Occupant rescue /Research methods; Submerged vehicle escape /Research methods; Submerged vehicle rescue /Research methods; Accident survivability; Accident survival time; Occupant rescue /Epidemiology; Occupant rescue /Vehicle characteristics; Vehicle flotation time; Occupant rescue /Behavior; Multidisciplinary teams /Accident survivability; Occupant rescue /Glazing materials; Flammability /Interior design; Fuel systems /Fires; Fire extinguishers; Fire prevention; Fire resistant coatings; Fire resistant materials; Combustion rate; Fires /Statistics

NHTSA DOCUMENTS

NHTSA Contractors Reports

HS-800 421 Fld. 5/22; 4/7

THE MECHANICS OF TIRES. NON-LINEAR DEFORMATION OF A THIN CURVED ELASTIC SHEET REINFORCED WITH IN-EXTENSIBLE FIBERS

by T. R. Steel; R. S. Rivlin

Lehigh Univ., Bethlehem, Pa., L04200

Dec 1970 23p
Contract FH-11-6090

This report considers the problem of a thin, initially curved elastic sheet, reinforced along one side by inextensible cords, and of infinite length in one direction, which is bent in the plane normal to this direction under the action of a uniform pressure acting along the reinforced side and applied loads acting on each end. A mathematical model is suggested for the solution of this problem based on the results of the finite cylindrical flexure of an initially circular cylindrical shell reinforced with inextensible cords. The motivation for considering this problem is the fact that the tension in the reinforcing fibers of a tire changes sign from tension to compression at a point in the sidewall very near to the tread; this will obviously be a possible point of fatigue.

Search terms: Tire research /

HS-800 429 Fld. 1/1; 5/14

ESCAPE WORTHINESS OF VEHICLES AND OCCUPANT SURVIVAL. FINAL REPORT. PT. 2: APPENDICES. PT. 3: RESEARCH AND DEVELOPMENT PLAN

Oklahoma Univ., Norman, O11350

Dec 1970 300p 977 refs
Contract FH-11-7303
Report no. 1729-FR-1-2; 1729-FR-1-3

Part 1 is a single volume and announced as HS-800 428.

This is a final report on the results of a multidisciplinary study of the factors involved in escape of occupants from crashed vehicle environments in which the vehicle is incapacitated on land, submerged in water or involved in fire. The report consists of three parts in two volumes. The SECOND PART contains

the appendices for the FIRST PART. Included are a bibliography, surveys of previous submergence tests, a detailed engineering analysis of submergence hydrodynamics, a summary of conventional flammability tests and test standards, and a compilation of the OURI ignition data and special absorbance measurements on vehicle interior materials. The THIRD PART presents a multi-year, interdisciplinary research and development plan designed to provide the information on crash survivability, to quantify the appropriate escape worthiness characteristics, to define substantive flammability test methods and performance criteria for flammability of vehicle interior materials, and to devise other control techniques and vehicle design features for fire prevention and control.

Search terms: Epidemiology/Bibliographies; Accident reports/Bibliographies; Accident studies/Bibliographies; Occupant rescue/Bibliographies; Bus accidents/Bibliographies; School bus accidents/Bibliographies; Vehicle design/Bibliographies; Vehicle kinematics/Bibliographies; Submerged vehicle escape/Bibliographies; Multidisciplinary teams/Accident survivability; Submerged vehicle rescue/Bibliographies; Fires/Bibliographies; Flammability/Bibliographies; Combustion/Bibliographies; Fuels/Bibliographies; Submerged vehicle rescue/Research; Vehicle flotation time; Submerged vehicle escape/Research; Occupant rescue/Research; Flammability/Research; Fires/Toxicity

HS-800 462 Fld. 3/5

PROJECT METER (MACHINE EXAMINATION, TEACHING, EVALUATION, AND RE-EDUCATION). AN EVALUATION

Washington. Dept. of Motor Vehicles, Olympia, W030000

Jan 1971 49p
Contract FH-11-6834

The objective of Project METER was to investigate the feasibility of the automated driver testing approach utilizing materials and expertise from three particular areas: programmed testing and learning, driving simulation, and driver examination and evaluation. METER was a centralized system composed of three testing subsystems: individual knowledge testing, group knowledge testing, and defensive driving testing with a driving simulator. Each subsystem was interfaced with a central computer. Operational evaluation demonstrated that the centralized systems approach was unsatisfactory and that separate testing systems should be utilized whenever possible. The group testing system proved unsatisfactory. Evaluation of software items demonstrated that both the knowledge and defensive driving tests could discriminate between drivers with good and poor driving records.

Search terms: Computerized driver testing/Feasibility studies; Driver license examination; Driving simulation/Defensive driving; Driver records/Driver evaluation devices; Driver evaluation devices/Feasibility studies; Driver education evaluation; Computerized driver testing/Evaluation

HS-800 483 Fld. 4/2; 2/0

COMMUNITY ACTION PROGRAM FOR TRAFFIC SAFETY. GUIDE 8. FINANCIAL AND TECHNICAL SUPPORT

by Mel D. Powell; Michael K. Gemmell; Donald Murray; Warren P. Howe

National Assoc. of Counties Research Foundation, Washington, D. C., N06600

Sep 1970 42p
Contract FH-11-7091

The support of highway safety programs at the local level should not be viewed as a number of unrelated activities separated according to the titles of the 16 highway safety standards, but must be implemented as a total program

requiring cooperation and sharing of resources among the local agencies involved. Administrative separation of functions can only result in a poor match between needs and resources. Support is discussed for driver and traffic safety education; codes and laws; traffic courts; alcohol programs; accident location identification; emergency medical services; highway design and maintenance and traffic control devices; pedestrian safety; police traffic services; debris control and cleanup; and support from the federal government and private sector.

Search terms: Highway safety programs/Community support; Driver education/Community support; Safety programs/Community support; Safety laws/Community support; Traffic courts/Community support; Alcohol usage deterrents/Community support; Accident location/Community support; Emergency medical services/Community support; Highway design/Community support; Highway maintenance/Community support; Traffic control devices/Community support; Pedestrian safety/Community support; Police traffic services/Community support; Debris removal/Community support; Federal aid/Highway safety programs; Local government/Highway safety programs

AVAILABILITY: NTIS

NHTSA Staff Speeches, Papers, etc.

HS-810 155 Fld. 5/4

ENERGY CONSIDERATIONS IN VEHICLE BARRIER IMPACT TESTING

by Paul R. Spencer

National Highway Traffic Safety Administration, Washington, D. C., N19900

Published in *Institute of Environmental Sciences Annual Technical Meeting Proceedings*, 1971, p71-7

30 refs

**NHTSA Staff Speeches, Papers,
etc. (Cont'd.)**

HS-810 155 (Cont'd.)

Presented at the 17th annual technical meeting and equipment exposition of the Institute of Environmental Sciences, Los Angeles, Calif., 26-30 Apr 1971.

A review of the literature on impact testing revealed that the problem of vehicle crashworthiness requires consideration of a wide range of impact directions and collisions with objects that are both movable and deformable. Reported testing has been done via head on collisions and virtually immovable and nondeformable barriers. The analytical study presented in this paper

provides initial quantitative test velocity comparisons between rigid barrier impact and the more general impact of a vehicle into a movable and deformable barrier.

Search terms: Barrier collision tests / Reviews; Barrier collision tests / Bibliographies; Barrier design / Deformation; Impact velocity / Barrier collision tests; Barrier collision tests / Fixed objects; Barrier collision tests / Impact angle



executive summary

A SYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

A STUDY PLAN FOR THE PREPARATION OF A HIGHWAY SAFETY PROGRAM FOR THE U. S. FOREST SERVICE

The purpose for this project was to investigate the problems associated with motor vehicular safety on the U. S. Forest Service multi-use roads and develop a usable plan for the conduct of a program-development project and produce recommendations whereby the Forest Service can, within a limited budget, improve and promote highway safety on the Forest Development Road System.

Contract No. FH-11-7468
Research Triangle Institute
P. O. Box 12194
Research Triangle Park
North Carolina 27709
DOT/HS-800 312 PB-195 697

Award Amount: \$12,000
Date Report Due: 9/1/70
Date Report Rec'd: 11/5/70
Release Date: 11/16/70

BACKGROUND AND GOALS

The Forest Service (FS) has under its jurisdiction approximately 200,000 miles of roads and several thousand drivers and vehicles. Until recently, most of the travel on these roads was by FS personnel and people involved with timber removal; but with the increased emphasis on outdoor recreation activities such as hiking, camping, hunting, and fishing, the road system traffic composition is changing from one involving primarily persons concerned with forestry management to one in which the driving population has little familiarity with the habits and eccentricities of backwoods driving. The purpose of this project was to:

- Gain insight into hazards which could be faced by inexperienced drivers preparing to use FS roads.
- Determination of critical safety factors for design, construction and maintenance of low budget roads and development of a program to bring the roads to a satisfactory safety condition.

- Identification of motor vehicle problems unique to mountain and forest driving.

The foregoing purposes could be stated as "Find those areas of the driver-road-vehicle interaction which are unique to FS roads, if any, and provide a safety program which will provide guidance that will achieve the greatest value of the FS road budget." The determination of the safety of FS roadways is a vexing problem.

The road network consists of three road classifications:

1. Land Access Road (LAR) - A multi-use road designed and constructed to provide access to and serve all resources.
2. Interim Development Roads (IDR) - A multi-use road designed and constructed more for public traffic than for Forest Service traffic.
3. Land Use Roads (LUR) - A road designed and constructed to serve a specific resource.

These three road classifications fit into the national road network at the "feeder" end (feed into major roads or highways). In the hierarchy of roads they are the roads with the lowest traffic volume and the greatest mileage.

In the highway safety field much of the safety campaign relies on statistics based on the historical trend of the road. Statistics are usually given as number of accidents per million vehicle miles or on a vehicle volume basis. This approach is fine when there are:

- Historical accident data over a fairly long period of time, and
- Traffic volumes are high enough to create the million-vehicle-mile base.

However, Forest Service roads are not in either class. These roads may have several features which, by nature of the use intended, are not considered safe. For example, there is little use of guard rails because the cost of providing them is not economically justifiable on low-volume roads. However, as a result of the very low traffic volume, there are few accidents.

Road safety as defined in the report includes all aspects of vehicular mobility in the forest. It also includes such things as all-weather mobility.

SUMMARY AND RECOMMENDATIONS

Recreational use of forests is on the increase. Those who have never driven on anything other than a city street and primary highways will expect signing, adequate clearances, services, and travel speeds higher than those which are now provided. To accommodate these people the road network may have to be broken down into sub-networks which will denote the road's primary purpose. The cost of upgrading mountain roads to a standard to which the average urban driver is accustomed would be both economically unfeasible and aesthetically destructive.

Based on the available data there is a subjective feeling that there is no safety problem unique to Forest Service roads. Interviews with FS personnel in regional offices and at national forests indicate a concern for safety because of the primitive nature of the roads, but at the same time little specific data concerning accidents resulting from FS roads.

Analysis of accident rates, for example, in Cherokee National Forest in Tennessee indicates an accident

rate of about 2.6 per million vehicle miles (MVM), compared to the higher rate for public rural roads, 7.3 per MVM.

Accident and fatality rates for FS personnel have not increased over the last eight years, although the trend in vehicle accidents in national forests resulting in serious injuries to the public has increased during the last five years.

A model for relating the likelihood of accident involvement to the volume for these low-volume roads has been formulated for the purpose of relating the decision for road upgrading or improvement to usage.

Based on the available data and discussions with FS personnel, the hypothesis is proposed that drivers on national forest roads, even though they appear hazardous, experience an accident rate no higher than that for similar highways built by other agencies. Perhaps an additional effort at safe driving is made by the drivers in these locations for they know that help, if it is needed, will be long in coming. This hypothesis needs to be tested by an experimental program and a data collection safety program.

Recommendations

The following recommendations by the contractor are suggested for near term implementation.

- The U.S. Forest Service should provide for a traffic safety record system by either accepting the entire responsibility within the FS or by providing for accident investigation by the local police authorities with responsibility by FS personnel for follow-up investigation, supplementing the accident reports used by the local authorities. Telephone calls and/or interviews with the witnesses and persons involved in the accidents for the purpose of obtaining answers to specific causal factors is necessary. A common format for all FS accident data collection is recommended. In this regard, some discussion with other governmental agencies with respect to a format for automatic data processing is suggested.
- One, and possible two, characteristic highest volume roads in each national forest should be selected for recording traffic volume. The precise data collection procedure should be provided initially in the safety program. These data will provide an exposure base for determining the extent of the safety problem.

- An arrangement with the Bureau of Motor Carrier Safety (BMCS) may be made for the purpose of investigating logging truck accidents as only a very small number of these accidents occur on FS roads.
- Methods for measuring the effectiveness of traffic control devices in forests should be developed during the early phases of the implementation of the FS Safety Program. These measures could be used to evaluate signing and other traffic control devices through an efficient experimental program.
- An investigation should be made of the relationship between safety and the nature of hazards (sharp curves and narrow, 2-way roads) introduced on FS roads.
 - There is a feeling on the part of many people that the safety problems may be more serious on the higher speed roads with few curves than on the low speed roads with many sharp horizontal and vertical curves and "hazardous" locations. Further review of the literature in regard to this conjecture and some preliminary study of how this hypothesis can be tested would be important for basic design, construction and maintenance philosophy.
- Design speed for the roads planned for general public recreational access use should be correlated with the desired speed of drivers as measured on stretches of road where roadway design elements do not control their speed. Those roads on which recreational access traffic is planned must have design speeds consistent with the desired speed of the motorist. A speed limit posting system similar to that suggested in the Traffic Engineering Handbook (P. 541) should be developed for the "recreation" routes based on data which could be obtained from the traffic flow characteristics found on purely recreational routes. There will be sections of road on which these speeds will be impossible to maintain. These sections should have signing and other communication devices such as rumble strips to indicate a change from higher design standards to lower ones.
- Sight distances for two-way, single lane roads are a critical design item. Adequate estimates of stopping distance must be found so that minimum design standards of road width and curve radius can be established.
- A relationship between the likelihood of a hazardous occurrence (accident) and the volumes (and speed) on low volume roads should be determined to provide a decision procedure for upgrading the design standard of an FS road. Additional data needs to be collected to estimate the unknown parameters of the flow models to the degree of precision required for this analysis.
- Methods for estimating the cost benefits of guard rails, guide posts, and breakaway signs should be formulated. These methods can then be used to allocate the limited resources available for such items. The general use of guard rails and locational sign posts would not be applicable throughout the national forests.
- More use should be made of outslope roads, particularly in areas of non-errosible soils because maintenance cost will be reduced when the traffic is low and vehicle speeds will be kept low.
- Investigation should be made of road types other than gravel. The FS personnel indicate that some studies are underway on other road types. Low volume-roads, and roads on which certain maintenance is being done (e.g., brushing), should be closed to the public (other than local residents) where the assurance of safe, unhindered passage becomes doubtful. Keeping the road open during maintenance can be a problem on single lane roads. Therefore in such cases, road closures by temporary signing might be appropriate.
- Logging trucks should be inspected frequently for brakes, stop and signal lights (these lights should be protected). Double tiedown straps should be used when these trucks are also used on public highways. Vehicle utilized on the roads in national forests in lumbering operation, along with non-lumbering vehicles should be required to meet the full State/Federal safety inspection at all times because off-the-road operation will destroy many safety items, i.e., brake lights, brake hoses, etc., which could increase the hazards.
- The extent of the alcohol problem should be determined on the basis of the traffic accident records obtained during the early phases of the FS safety program.
- In those areas where less than two or three vehicles traverse a road in a day, consideration should be given to closing the road to general public use or using a driver registration system (check in and check out), and suggesting a means of notification

and warning of the potential hazards.

- The use of innovative signs or techniques for educating drivers upon entering the national forest should be considered.

The Contract Manager has certified that the Contractor's work has been satisfactorily completed and that all

contractual obligations have been met.

The opinions, findings, and conclusions expressed in this summary are those of the contractor and not necessarily those of NHTSA.

Availability: This report may be ordered in paper copy (PC) or microfiche (MF) from NTIS. Order by DOT/HS-800 312 or PB-195 697.



U.S. DEPARTMENT OF TRANSPORTATION NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

WASHINGTON, D.C. 20591

OFFICIAL BUSINESS

Penalty For Private Use, \$300



POSTAGE AND FEES PAID
FEDERAL HIGHWAY ADMINISTRATION

NHTSA REGIONAL OFFICES

Region	Address
I	Regional Administrator, NHTSA, Transportation Systems Center, 55 Broadway, Cambridge, Mass. 02142, Tel: 617-494-2681. (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont)
II	Regional Administrator, NHTSA, 4 Normanskill Blvd., Delmar, N.Y. 12054, Tel: 518-427-4095. (New Jersey, New York, and Puerto Rico)
III	Regional Administrator, NHTSA, Room 817 Federal Building, 31 Hopkins Plaza, Baltimore, Maryland 21021, Tel: 301-962-3878. (Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia)
IV	Regional Administrator, NHTSA, Suite 200, 1720 Peachtree Road, N.W., Atlanta, Georgia 30309, Tel: 404-526-3405. (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee)
V	Regional Administrator, NHTSA, 18209 Dixie Highway, Homewood, Illinois 60430, Tel: 312-799-6300. (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin)
VI	Regional Administrator, NHTSA, 819 Taylor Street, Room 8A42, Fort Worth, Texas 76102, Tel: 817-334-2021. (Arkansas, Louisiana, New Mexico, Oklahoma, and Texas)
VII	Regional Administrator, NHTSA, P.O. Box 7186, Country Club Station, Kansas City, Missouri 64113, Tel: 816-361-7887. (Iowa, Kansas, Missouri, and Nebraska)
VIII	Regional Administrator, NHTSA, Room 107, Bldg. 40, Denver Federal Center, Denver, Colorado 80225, Tel: 303-233-6429. (Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming)
IX	Regional Administrator, NHTSA, 450 Golden Gate Avenue, Box 36096, San Francisco, California 94102, Tel: 415-556-5450. (Arizona, California, Hawaii, and Nevada)
X	Regional Administrator, NHTSA, Room 301, Mohawk Bldg., 222 S.W. Morrison Street, Portland, Oregon 97204, Tel: 503-226-3754. (Alaska, Idaho, Oregon, and Washington)